

THRUSTY TRENT
ROLLS-ROYCE GETS SET FOR A350-1000 TEST PROGRAMME
FEATURE P28

FATAL ERROR
NTSB report details crew mistake which caused loss of SpaceShipTwo – and grounded Virgin Galactic **8**

GOING NOWHERE
US Air Force rules out international transfer of A-10 Warthogs destined for Arizona boneyard **21**

FLIGHT INTERNATIONAL

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4-10 AUGUST 2015



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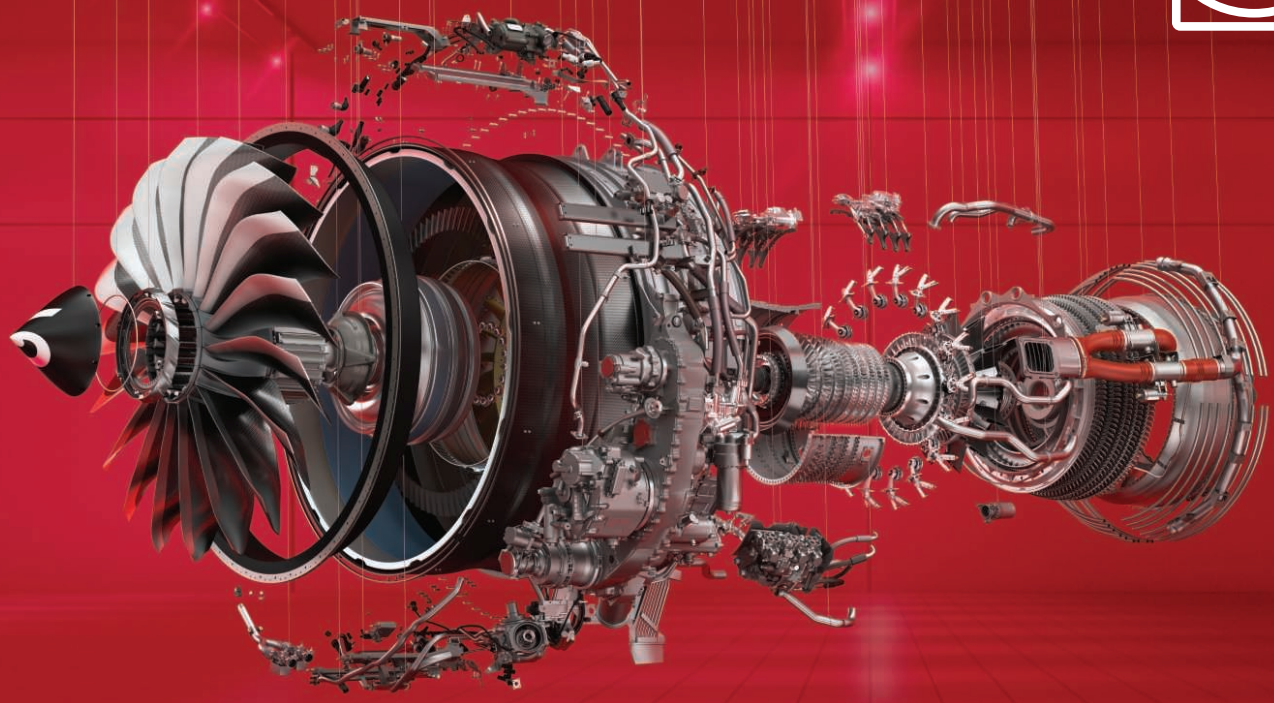
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AirTeamImages

COVER IMAGE

A "middle of the market" type could replace Boeing 757s like this Rolls-Royce RB211-engined American Airlines example, pictured departing Brussels P26



BEHIND THE HEADLINES

James Drew (*pictured*) was in **St Louis, Missouri**, to witness the **Royal Australian Air Force**'s first **EA-18G Growler** rolling out (**P10**). In **Derby**, **Murdo Morrison** paid a visit to **Rolls-Royce**, for an update on the A350-1000's **Trent XWB-97** engine (**P28**)



Boeing

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Our annual Airliner Census lists the current commercial types in operation around the globe, by model and carrier

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IMAGE OF THE WEEK

Taken during the bilateral Indradanush IV exercise being conducted from the UK Royal Air Force's Coningsby base, this image shows a formation of Eurofighter Typhoons and Sukhoi Su-30MKIs. India also sent Boeing C-17 and Lockheed Martin C-130J transports and an Ilyushin Il-78 tanker

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THE WEEK IN NUMBERS

26%

Triumph Group

Q2 aerospace systems sales surged to $278m at Triumph Group; total quarterly revenue gained 7% to $959m

€154m

Finmeccanica

Finmeccanica's H1 2015 pre-tax profit more than reversed last year's €28m loss; sales dipped 4.4% to €5.97bn

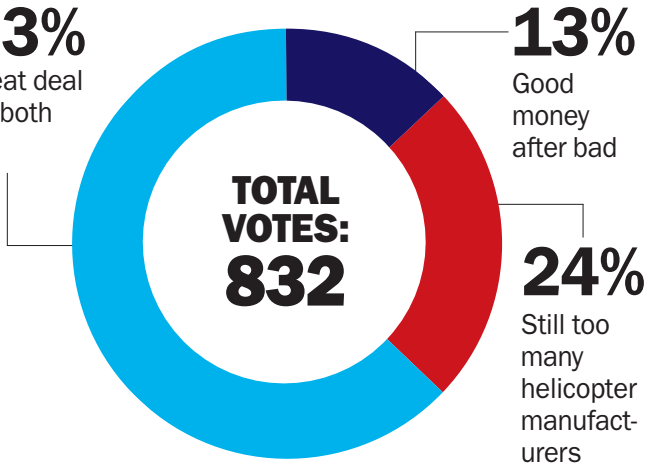
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Flightglobal dashboard

The number of Airbus A350-900 production slots now held by Singapore Airlines, after it released seven positions

QUESTION OF THE WEEK

Last week, we asked: **Lockheed Martin's plan to acquire Sikorsky?**
You said:



This week, we ask: **Can Airbus still deliver its first A320neo in 2015?**
❑ Yes, comfortably
❑ Touch and go ❑ Not a chance
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Reality check

The new and exciting commercial spaceflight sector must recover from the damaging loss of SpaceShipTwo, but the imposition of unrealistic safety standards could keep it Earth-bound

The US National Transportation Safety Board (NTSB) has exposed lapses by Scaled Composites and the US Federal Aviation Administration ahead of the fatal crash of Virgin Galactic's SpaceShipTwo, which it says compounded the primary cause of human error.

Its involvement raises an interesting question: What standard of safety should commercial spaceflight be held to during its early days? That of the modern-day airliner, or something closer to aviation's early days, when risks – and accident rates – were higher?

Some would argue that the FAA's regulators should be applying airline-style standards for both design and operations, to protect participants – some are daring pioneers, but mostly they are employees, however much they like their job – and also to protect members of the public; be they passengers or bystanders.

Meanwhile, the FAA has been heavily criticised by the suborbital space crowd for squelching their nascent industry with regulations intended to cover a mature and already safe mode of transport. As a result, the FAA relaxed or waived certain regulations, as revealed following the October 2014 SpaceShipTwo disaster.

Applying airline standards to commercial spaceflight could destroy the industry

Applying airline standards to commercial spaceflight could destroy the industry, as it takes years, or decades even, to achieve the same kind of safety levels that subsonic airliners now deliver.

There are always tensions between regulators trying to guarantee a certain level of safety and an industry trying to do what nobody else has done before.



Rex Features

Not exactly like boarding a 737

Scaled Composites embodies the spirit of the private spaceflight industry. If you want an experimental or advanced hobbyist aircraft, it is ideal. If you are also willing to take some of the same risks as test pilots, again it is the right place, as the infrastructure and culture are set up to support experimental operations.

Applying the FAA's certification requirements for passenger-carrying aircraft to that culture makes sense if you want to protect the lives of all involved. But will it come at the expense of the viability of the industry?

Scaled Composites had never before had a test flight end in a crash. But it is the kind of firm that relies on highly trained test pilots to not make simple mistakes in extreme situations.

The aftermath of the SpaceShipTwo crash suggests that private spaceflight may face standards higher than, say, NASA's fleet of space shuttles. To the FAA and NTSB, a suborbital spacecraft might as well be a Boeing 737. If that view prevails, the dream of routine, private spaceflight will never be realised. ■

See This Week P8

Smart money goes on takeovers

GKN's takeover of Fokker Technologies may not have the transformative impact on either company of the 2013 deal that brought Volvo Aero into the GKN fold, or indeed its 2009 purchase of Airbus's wing works at Filton. But don't underestimate the significance of the deal, internally at both companies and for the broader aerospace industry.

Internally, the deal secures the future of Fokker, which has seen hard times, rejuvenation, ownership changes and strategy overhauls since the demise of the aircraft types which bear its name. GKN should benefit smartly from the Fokker heritage. The Dutch company no longer makes aircraft, but it retains the DNA of an aircraft maker – hard to define but no small advantage for GKN, as major tier 1s like itself increasingly become top-line partners in new aircraft programmes.

The wider implications are also encouraging. Like GE's 2013 acquisition of Avio Aero, the Fokker deal is a successful exit by a private equity investor, a story that has been all too rare since the financial crisis.

Private equity and its attendant management skill is an invaluable lubricant in an industry with a supply chain of small-to-medium businesses that often struggle to keep pace with the demands of the heavy hitters they sell to. But private equity only works if it can get out at a profit. Let's hope that more big players like GKN and GE are eager to buy. ■

See This Week P9

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BRIEFING

BLUE ANGELS DISPLAY PROMPTS FUEL EMERGENCY

OPERATIONS The pilots of an Allegiant Air Boeing MD-80 declared a fuel emergency on 23 July after being delayed on reaching Hector International airport in Fargo, North Dakota, and finding it closed for a practice session by the US Navy's Blue Angels aerobatic display team. The MD-80, which had been operating a flight from Las Vegas, Nevada, did not have sufficient fuel to reach a suggested diversion airport about 61nm (113km) away. The carrier is investigating the incident with the assistance of the US Federal Aviation Administration.

SINGAPORE REDUCES A350-900 ORDER

FLEET Singapore Airlines has signed an agreement with Airbus to release seven production slots for the A350-900, reducing its firm order for the type to 63 aircraft, plus 20 options. The carrier – which had previously planned to receive the cancelled -900s during the 2017-2018 and 2018-2019 financial years – says the decision "will not materially affect fleet renewal or growth plans".

TEXTRON REPORTS MIXED SECOND QUARTER

BUSINESS AVIATION A strong US dollar, coupled with challenging international markets, contributed to a mixed second quarter for Textron Aviation's Cessna and Beechcraft divisions. Deliveries of Citation jets remained stable at 36 between April and June, but King Air shipments fell to 30, compared with 34 during the same period of 2014. These contributed to a 5% decrease in revenue for the same period, to $1.12 billion. But profit jumped to $88 million, compared with $28 million a year earlier.

EMIRATES RETURNS ITS LAST 777-200

RETIREMENT Emirates has returned its last Boeing 777-200 to lessor Veling; one of 10 aircraft that it will remove from use in the fiscal year ending 31 March 2016. The Dubai-based carrier has phased out four 777-200s and eight Airbus A340-500s over the past two years. It took delivery of 24 new aircraft in 2014-2015, and will receive another 26 during the current fiscal year.

H135 EDGES CLOSER TO AUSTRALIAN DUTY

ROTORCRAFT Airbus Helicopters has obtained factory acceptance for the first of 15 H135 rotorcraft bound for use under the Australian army and navy's Helicopter Aircrew Training System programme. The aircraft will be shipped from Donauwörth in Germany next January, following its provision of instruction for aircrews and technicians, including from prime contractor Boeing Defence Australia.

AIR BAGAN ATR 72 DAMAGED IN YANGON

MISHAP France's BEA investigation authority says an ATR 72-200 being operated by Myanmar's Air Bagan suffered a collapse of its left main landing gear before veering 75ft off the side of Yangon's runway 21 on 24 July. The nose wheel of the turboprop (XY-AIH) was also damaged during the accident, which happened in rain and reduced visibility. Only minor injuries were reported among the 54 occupants.

JSOW DEALS ON TARGET FOR RAYTHEON

ORDERS Raytheon is to produce 200 AGM-154-C1 Joint Stand-Off Weapons (JSOW) for the US Navy, for $58 million. Weighing 475kg (1,050lb) and with a range of 70nm (130km) when released from 40,000ft, the datalink-equipped version is in operational testing with the Boeing F/A-18E/F Super Hornet. Additionally, Saudi Arabia will receive 355 Block III C-model weapons for $123 million.



Rex Features

The vehicle broke up after spinning beyond structural design limits

SAFETY **STEPHEN TRIMBLE** WASHINGTON DC

SS2 hazard study 'was incomplete'

NTSB says failure point that caused SpaceShipTwo crash could have been addressed, as it outlines chain of events

A co-pilot's fatal mistake that led to the break-up of SpaceShipTwo represented a single-point failure that could have been addressed long before the crash last October, according to the US National Transportation Safety Board (NTSB).

A required hazard analysis completed by Scaled Composites failed to anticipate that a single mistake by the co-pilot could lead to an inflight break-up, the NTSB said on 28 July. The US Federal Aviation Administration's office of commercial space transportation had concluded that Scaled's hazard analysis was incomplete, but issued the company an unsolicited waiver, reasoning that pilot training and experience mitigated the risk of human error, it adds.

"We cannot undo what happened, but it is our hope that through this investigation we will find ways to prevent such an accident from happening again," says NTSB chairman Christopher Hart, opening its first ever hearing on the crash of a manned commercial spacecraft.

The 31 October flight was piloted by Peter Siebold, who survived, and co-pilot Michael Alsbury, who was killed when SpaceShipTwo broke up.

SpaceShipTwo had been carried to an altitude of around 46,000ft by WhiteKnightTwo, a twin-boomed mothership, and released. Siebold then correctly commanded Alsbury to fire the spacecraft's rocket motor, but the latter made a tragic mistake by unlocking the spacecraft's twin-boomed feathers.

Alsbury was already in a stressful position, trying to remember critical tasks that had to be performed in a short period, the NTSB notes. It is not clear if he remembered a three-year-old training lesson that warned pilots aerodynamic forces would overwhelm the feathers if they were unlocked too early, but was more likely aware that if he forgot to do so by the time the vehicle reached Mach 1.8, the flight would have to be aborted.

Mere seconds after Alsbury unlocked the feathers, SpaceShipTwo pitched up suddenly as aerodynamic forces spun the vehicle beyond structural design limits, leading to complete structural failure.

Virgin Galactic founder Richard Branson says engineers have since designed a "mechanism to prevent the feather from being unlocked at the wrong time".

"With the investigation completed, Virgin Galactic can focus fully on the future with a clean bill of health and a strengthened resolve to achieve its goals," he says. ■



First RAAF Growler rolls out
THIS WEEK P10

PROGRAMME STEPHEN TRIMBLE WASHINGTON DC

Bombardier to delay Global 7000 in face of 'challenges'

Bellemare says schedule for business jet's entry into service will be put back by two years

Bombardier has announced a two-year delay for the entry into service of the Global 7000 business jet, blaming unspecified development "challenges". The first 7,300nm (13,520km)-range aircraft will now be delivered in the second half of 2018, it says.

In a second-quarter results teleconference on 30 July, the company did not disclose a schedule revision for the even longer-range Global 8000, which was originally scheduled to enter use in 2017.

The new family will feature the first "purpose-built, four-[cabin]-zone aircraft" in the business jet market, Bombardier chief executive Alain Bellemare told analysts. The Global 7000 also incorporates an advanced wing optimised for both long-range and short-field take-off performance, he says.

"These challenges have impacted the programme schedule," he says, adding: "I am confident in our aircraft and our ability to deliver to the revised schedule."

The delay comes three months after Bombardier announced plans to cut production of the Global 5000/6000 business jets to between 50 and 60 aircraft per year – down from the current rate of 80-85.



Bombardier

A first flight-test example is currently in the final assembly stage

Sales of Bombardier's business jets were slow in the second quarter, Bellemare says, noting soft demand from China, Russia and Latin America. Although third quarter sales activity has been "good" so far, he says, the company still believes it made the right decision to proactively reduce build rates.

Earlier this year, the company also announced an indefinite pause to its Learjet 85 development programme.

The Global 7000, powered by GE Aviation Passport engines and featuring Rockwell Collins Pro-Line Fusion avionics, represents the company's response to new rivals such as the Gulfstream G650 and the Dassault Falcon 5X/8X. Bombardier's first flight-test example of the Global 7000 is now in the final assembly stage, Bellemare says. ■

SEARCH ELLIS TAYLOR SINGAPORE

Malaysia examines 'MH370 flaperon'

Officials from Malaysia's Department of Civil Aviation will examine a piece of wreckage that washed ashore on La Reunion island for any potential link to the disappearance of Malaysia Airlines flight MH370. The part resembles the flaperon section of a Boeing 777-200ER, and an identification number reportedly seen on the part bears strong similarities to the manufacturer's maintenance classification codes for trailing-edge structures on the type.



PA

The wreckage was washed ashore on La Reunion island

On 30 July, Australia's government – which has been overseeing a search effort for debris from the missing aircraft – acknowledged the discovery of the component, and said: "In the event that the wreckage is identified as being from MH370, it would be consistent with other analysis and modelling that the resting place of the aircraft is in the southern Indian Ocean."

Malaysia Airlines cautions that it is "too premature for the airline to speculate on the origin of the flaperon". ■

TAKEOVER DAN THISDELL LONDON

GKN to acquire power of Fokker Technologies

GKN Aerospace has "strengthened its position" in wings and composite aerostructures with a proposed €706 million ($775 million) takeover of Fokker Technologies, and has also bought its way into an electrical wiring capability that it believes will prove hugely valuable as aircraft become increasingly electric.

Company chief executive Kevin Cummings tells *Flight International* that Fokker's Elmo wiring and interconnections business is probably number three in the market, and very strong in design and systems integration. That capability broadens GKN's market reach, he says, as aircraft adopt more electrical systems and designers look to save weight and improve performance by embedding electricals in composite structures.

Once combined, GKN will have "probably the most complete composite base out there for aerostructures", Cummings says.

Fokker will also bring technology in the landing gear segment, where it is a supplier to the Lockheed Martin F-35 and NH Industries NH90, and boost GKN's Asian headcount to 8-10% of its global workforce.

About a quarter of Fokker's turnover – €758 million in 2014 – is in aftermarket services to the legacy Fokker fleet and other types. GKN has its own such business, in engines, having bought Volvo Aero for £633 million in 2012, but Cummings says it will bring the two units into line and look for growth and ways to "be a smart operator in that arena".

Unlike GKN's takeovers of Volvo Aero and Airbus's wing-making unit at Filton – acquired in 2009 for £136 million – the Fokker deal stands out in aerospace as a successful private equity exit by Fokker's current owner, Arle Capital.

The deal remains subject to regulatory approval, but is expected to close in the fourth quarter of this year. ■

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PROGRAMME
STEPHEN TRIMBLE WASHINGTON DC

Embraer reveals two-year setback to KC-390 target

Embraer has delayed the certification target for its KC-390 tanker-transport to the second half of 2017, and entry into service until 2018.

Made in the company's second quarter earnings statement on 30 July, the disclosure represents a delay in the programme of up to two years.

The Brazilian company completed a first flight of the KC-390 from its Gavião Peixoto plant on 3 February, but it is not clear if the International Aero Engines V2500-powered aircraft has returned to the air since.

Embraer says its formal flight test campaign will begin during the third quarter and last for 18 to 24 months.

Embraer has not disclosed how the delay will affect the cost of the KC-390's development phase. The Brazilian air force launched the programme in 2009, awarding the company a roughly $1.5 billion contract to build two prototypes.

The service later ordered another 28 to replace its ageing Lockheed Martin C-130s, while five other countries have made commitments to acquire a combined 32 more. ■

PRODUCTION JAMES DREW ST LOUIS

First RAAF Growler rolls out

Initial example of 12 electronic attack aircraft on order for Canberra is unveiled in Missouri

Boeing has rolled out the first of 12 EA-18G Growler electronic attack aircraft for the Royal Australian Air Force (RAAF), and remains optimistic of continuing production on its Super Hornet line for the rest of the decade.

Unveiled in St Louis, Missouri on 29 July, aircraft A46-301 was first flown on 13 July. A second example also has now entered flight testing.

After being delivered later this month, the pair will be flown to NAS China Lake in California, where Australian pilots are already training with their US Navy counterparts.

The aircraft will also visit the latter's home of airborne electronic warfare at Whidbey Island in Washington, before heading for Australia in 2017.

Introduction of the EA-18G will be a significant milestone for the RAAF, which will gain the ability to shut down enemy surface-to-air missile, radars, electronic transmissions and communications equipment across a wide area.

"It is truly a unique capability, critical to our future operations," says former RAAF chief Air Marshal Geoffrey Brown, who attended the roll-out ceremony.



Boeing

Australia's first EA-18G made its debut flight on 13 July

Unlike USN examples, Australia's Growlers will carry Raytheon's Advanced Targeting Forward-Looking Infrared (ATFLR) pod and AIM-9X Sidewinder air-to-air missiles, and are eventually expected to gain Next-Generation Jammer equipment.

"Our timeline will be the same as the US Navy," says Brown. "As the US Navy upgrades this airplane, we'll stay lock-step."

Daniel Gillian, vice-president of F/A-18 and EA-18G programmes, says Boeing has decided to run its mixed-model assembly line at a rate of two aircraft per month starting in the first quarter of 2016. It currently completes three, having dropped the production rate from four per month last year.

Production of the Growler is currently expected to wrap up in December 2017, but a USN order for 12 more Super Hornets and a potential sale of 24-36 to an unnamed "Middle East customer" – said to be Kuwait – would sustain the line through 2019 or 2020.

"The momentum is behind the Super Hornet, and we see that holding up," Gillian says.

Separately, Boeing has delivered Australia's seventh C-17 strategic transport to Amberley air base in Queensland, following an order confirmed during April. A final example will follow late this year. ■

RESULTS KATE SARSFIELD LONDON

Gulfstream sales soar on tailwinds of US economy

Gulfstream recorded its best second quarter for new aircraft sales since 2008, thanks mainly to a thriving US economy.

In an earnings call on 29 July, Phebe Novakovic, chief executive of Gulfstream's parent company General Dynamics, dismissed competitors' talk of a slumping business jet market as "speculation" and "rumour intelligence". This was a reference to Bombardier and Dassault, which have both witnessed a decline in sales.

Gulfstream's orderbook grew by nearly $1 billion to more than $14 billion, with a book-to-bill ratio exceeding 1:1.

"The orderbook is very robust and the sales pipeline remains steady across all models," Novakovic says. Increased demand for its flagship G650 family has persuaded Gulfstream to boost production, by "feathering in an extra aircraft here or there into the schedule," she adds.



Gulfstream

The company has boosted production of its flagship G650 family

North America dominated the orderbook in the second quarter. "We saw a return of Fortune 500 companies, which are now placing orders to replenish their fleets," Novakovic says.

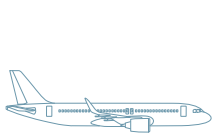
Gulfstream delivered 41 business jets between April and June, compared with 38 during the same period last year. Large-cabin shipments climbed by seven units to 33, while midsize deliveries fell by four aircraft, to eight. ■

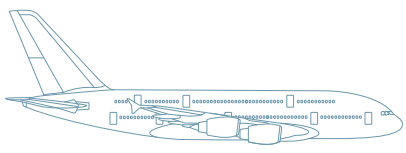


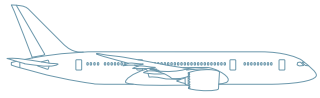
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Investigators call for action on MD-80 engine icing flaw
AIR TRANSPORT P14

UPDATES JAMES DREW WASHINGTON DC

Non-lethal weapon options make it onto AFSOC hit list

Commander wants defensive lasers and microwave weapons on AC-130J this decade

US Air Force Special Operations Command (AFSOC) chief Lt Gen Bradley Heithold has outlined a "five-year plan" to install directed energy weapons onto several of its new Lockheed Martin AC-130J Ghostrider gunships. Some older AC-130Us set for retirement have been earmarked to act as flying testbeds for technologies including lasers and microwave energy weapons.

Speaking at a Center for Strategic and Budgetary Assessments directed energy summit in Washington DC on 28 July, Heithold said a laser would be used initially to defend against missiles and to disable cars, boats, small aircraft and communications equipment. An active denial system, or microwave energy gun, would be used to target threatening crowds or individuals on the ground.

Heithold says the AC-130J already has plenty of firepower, with the recent addition of a 105mm cannon, but that it also needs "non-lethal modes" to give crews other options in the near-term.



US Air Force

The "Ghostrider" has a 105mm cannon, but needs more flexibility

"If I don't do something in the next five years or so, the area and times I will be able to employ an AC-130 gunship will continue to shrink," he says. "I must look for new ways of defending the airplane. High-energy lasers offer me that defence against missiles."

US Air Force Research Laboratory commander Maj Gen Tom Masiello says a pod-housed laser demonstrator is being developed for the Boeing F-15E, but that it will also explore AC-130-based demonstrations.

The US Department of Defense is currently spending about $300 million per year on directed energy research and demonstrations. ■

POLICY BETH STEVENSON LONDON

Pilot body calls for right focus in UAV regulations

The European Cockpit Association (ECA) has called for proposed regulations on unmanned air vehicles to focus on the safety of people and manned aviation, and not the rights of the recreational operators who fly them.

First outlined by the European Aviation Safety Agency in March, the proposal suggests that the operation of UAVs in civil airspace be proportionate to the risk each poses, and recommends they be divided into three categories: open, specific and certificated.

According to its proposal, aircraft categorised as "open" would not require authorisation from an aviation authority, but would need to stay within defined boundaries.

While acknowledging UAVs have potential benefits, the ECA notes it is "absolutely critical that the technology is introduced safely, in particular with regard to existing manned aviation".

A draft regulatory framework is to be presented to the European Commission by EASA by the end of 2015. ■

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PROGRAMME
STEPHEN TRIMBLE WASHINGTON DC

P&W-powered A320neos back in flight testing

Airbus has resumed flying its Pratt & Whitney PW1100G-powered A320neo flight test aircraft in Toulouse, after a three-month grounding.

The enforced halt in testing was traced to a fault in a 25.4cm (10in)-diameter snap ring in the heart of the engine with the combustor module.

P&W acknowledges that it inadvertently skipped a step when the snap ring was manufactured. The part needs to be pre-stressed so that it does not slightly change shape when exposed to the intense heat around the combustor module, but P&W says this did not occur for a batch of snap rings.

Airbus was forced to ground its two PW1100G-powered A320neo test aircraft while P&W installed new snap rings. Despite this delay, Airbus says the A320neo is still scheduled to be delivered to launch customer Qatar Airways by the end of this year. ■

CONFIGURATION

VietJet finds space for first 230-seat A321

Vietnamese low-cost carrier VietJet Air has become the initial operator of the 230-seat, high-density Airbus A321.

The narrowbody had previously been restricted to a 220-passenger maximum, but internal configuration changes using the airframer's SpaceFlex system – including relocation of the aft lavatories and galley, plus the use of slimline seats – have enabled the higher capacity.

Bearing the registration VN-A660, VietJet's latest A321 is also equipped with sharklet wing-tip modifications. The delivery takes the carrier's fleet to three A321s and 23 A320s. It has orders in place for an additional 51 Airbus narrowbodies. ■

INQUIRY DAVID KAMINSKI-MORROW LONDON

Investigators call for action on MD-80 engine icing flaw

Lessons must be learned from fatal Swiftair crash, says joint French and Malian report

French and Malian investigators are advising a mandatory change to Boeing MD-80 flight manuals to highlight the insidious effects of engine icing.

Their recommendation follows the fatal loss of a Swiftair MD-83 in July 2014, which has been attributed to an undetected speed decay triggered by inaccurate engine pressure ratio data.

Investigators believe the crew did not activate the anti-icing system for the pressure probes on the nose cones in the MD-83's Pratt & Whitney JT8D engines. The probes became obstructed by ice as the aircraft – which had departed Ouagadougo in Burkina Faso – diverted around convective weather shortly after reaching a cruise altitude of 31,000ft.

As a consequence, the probes relayed an overestimate of the engine pressure ratio and the aircraft responded by reducing thrust to bring the figure within authorised limits. The decreasing speed went unnoticed until the aircraft began to stall.

All 116 passengers and crew were killed in the accident.



AirTeamImages

MD-80 crews currently receive no warning of approaching stall

French investigation authority BEA and the Malian commission of inquiry have recommended that MD-80 flight manuals be modified to draw crews' attention to the risks associated with engine probe icing during cruise, even in the absence of other visible evidence of ice accretion.

> **"Detection of this inconsistency would enable crews to react before the aircraft approached a stall"**
> **BEA/MALIAN INQUIRY**

"As of today, documents such as the [flight manual] do not contain specific procedures to allow crews, on the basis of indicated engine parameters, to quickly bring to light a situation with inconsistent [engine pressure data] resulting from obstruction of the [engine probes]," the inquiry states. "Detection of this inconsistency would enable crews to react before the [aircraft] dangerously approached a stall situation."

The recommendation says pilots should be provided with a means to quickly identify, and remedy, an erroneous pressure-ratio reading. ■

INCIDENT GREG WALDRON SINGAPORE

JAL suspends crew after take-off error

Japan Airlines (JAL) has suspended the crew of a Boeing 767-300ER that mistakenly commenced their take-off run on a taxiway at Singapore's Changi International airport.

The incident occurred while the aircraft was operating flight JL38 to Tokyo Haneda at roughly 02:30 on 12 July, says JAL.

The carrier only became aware of the incident when it was contacted by Singapore authorities 11 days later.

JAL says that immediately after starting the take-off run, the crew realised their error and aborted the take-off. The aircraft was subsequently directed to the runway and departed without further incident.

There were 10 crew members and 198 passengers aboard.

Flightglobal's Ascend Fleets database shows that the aircraft involved bears the registration JA606J. It was delivered in 2003 and is powered by General Electric CF6 engines. ■



AirTeamImages

The incident occurred on a taxiway at Singapore's Changi airport



Captain's judgement cited in crash investigation
AIR TRANSPORT P16



Rex Features

A British Airways A319 lost both engine cowls on take-off in 2013, causing damage to the right-hand powerplant, a fuel leak and fire

SAFETY **DAVID KAMINSKI-MORROW** LONDON

Airbus rethinks A320 cowl-loss alerts

Toulouse evaluating cockpit-warning system and new latches to address incidents arising from unsecured fan-cowl doors

Airbus is considering implementing a cockpit-warning system for the A320neo which would alert pilots if the engine fan-cowl doors are not secure.

The system would monitor the condition of the cowl locks and provide a warning to the crew if they are unlatched.

The airframer is looking at making such a system available from service entry of the re-engined aircraft type, which is scheduled to take place before the end of this year.

It would form part of a rethink on the problem of cowl-loss, particularly in the wake of the British Airways A319 event in May 2013 when both engines shed their cowls on take-off. The right-hand engine's fuel system was damaged, resulting in a fuel leak and fire.

UK investigators said that this was "by far the most serious" of the 38 cowl-loss incidents to date involving A320-family aircraft.

The airframer has previously resisted pressure from investigators to devise a warning system, citing complexity, weight and cost, and believing that the solution to unlatched cowls lay in simpler measures centred on the locks. But such measures – including high-visibility paint on the latches and mechanisms designed to keep unlocked cowls slightly open – have not proven as effective as desired.

WARNING FLAG

While the rate of incidents has halved since 2002, to around one in 2.4 million cycles, the proliferation of the A320 has resulted in twice as many cowl losses involving aircraft with these measures in place.

Airbus says it is adopting a multi-faceted approach to preventing the problem, which will encompass design, operational and training aspects.

As well as the cockpit-warning system being considered for the A320neo, the airframer has been developing a new latch system for the current A320 models.

This involves a dedicated key to open the latch, to which is attached a red warning flag. The key cannot be removed while the latch is open, so the flag will dangle visibly below the engine nacelle if the cowl has been closed but not locked.

Airbus says it intends to make this latch a line-fit on production aircraft and the mechanism will be available as a retrofit from early 2016.

Mechanical solutions will be "incorporated in parallel" on the A320neo, the airframer adds. The manufacturer has also revised maintenance procedures to require an entry in the aircraft's logbook when the cowls are open, which has to be closed off once the cowls have been shut and latched.

> **"There is a marked correlation between the cowl loss and the position of the engine's latches"**
> **UK AAIB**

Investigators have attempted to determine the contributing elements to A320 cowl-loss events by analysing the circumstances of the recorded incidents.

Both engine types – the International Aero Engines V2500 and CFM International CFM56 – have been affected. But the UK Air Accidents Investigation Branch (AAIB) says there is a "marked correlation" between the cowl loss and the position, inboard or outboard, of the engine's latches. The V2500 cowl has latches on the right side of the engine, while the CFM56 cowl is latched on the left.

VIEWING WINDOW

An engine with its latch positioned on the inboard side was three times more likely to be the subject of a cowl loss than when located towards the outer wing, the analysis found.

More than two-thirds of the events examined for the analysis followed the opening of the cowl for checking or servicing of the oil level in the engine's integrated drive generator.

Airbus has doubled the oil-level check interval, says the inquiry into the BA event, in order to reduce the number of occasions that the cowl needs to be opened. It has also introduced an optional viewing window on CFM56 engines enabling the generator's oil level to be checked without opening the cowl at all. ■

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PILOTS EDWARD RUSSELL
WASHINGTON DC

Republic union row adds to list of labour woes

Republic Airways anticipates reductions to its scheduled flying through the middle of 2016, as labour issues continue to take their toll.

"The company has initiated discussions with our mainline partners to take the necessary actions to both temporarily and permanently reduce scheduled flying commitments for the remainder of 2015 and the first half of 2016," warns the Indianapolis-based regional carrier.

The decrease in flying at its Republic Airlines and Shuttle America operating units is likely to translate to fleet reductions, it adds.

The carrier attributes the move to changes to pilot qualification standards mandated by the US FAA

Republic operated a combined 242 regional jets for American Airlines, Delta Air Lines and United Airlines at the end of March, it says. It had planned to increase this to 249 by the end of 2015 – including by adding the first 15 of 55 Embraer 175s to its fleet with United – and 263 by late 2016.

The carrier attributes the move to changes to pilot qualification standards, mandated by the US Federal Aviation Administration since 1 August 2013, and a tightening of pilot flight and duty times, which came into effect on 1 January 2014. Both have contributed to a "growing pilot shortage", while the latter has cut pilot productivity by 5-7%, it claims.

A burgeoning row with the Teamsters union, which represents Republic pilots, "is further amplifying our pilot staffing challenges", the company says, describing demands as "unrealistic". The union counters that the carrier has not updated its contract since 2007. ■

SAFETY JON HEMMERDINGER WASHINGTON DC

Captain's judgement cited in 737 crash investigation

Report says unstabilised approach mishandled during incident that led to eight minor injuries

US accident investigators have determined that an unstable approach and the captain's decision to take command of the aircraft at low altitude contributed to the crash of a Southwest Airlines Boeing 737-700 at New York's LaGuardia airport on 22 July 2013.

"The captain should have called for a go-around when it was apparent that the approach was unstabilised well before the point that she attempted to salvage the landing by taking control of the airplane at a very low altitude," says a National Transportation Safety Board (NTSB) report.

The 737 (N753SW) was operating flight 345 from Nashville, Tennesse, with 149 passengers and crew. It "landed hard", with its nose gear hitting the runway first, says the NTSB. The force of the impact was sufficient to drive the nose gear strut into the electronics equipment bay, causing the twinjet to veer to starboard before stopping on the right side of the centreline of LaGuardia's runway 4.

Eight of those on board suffered minor injuries, and the aircraft was written off following the mishap.

Investigators found the co-pilot was conducting the landing, with the pilot monitoring. On final approach, the latter, noticing that the flaps were not set at 40° – the proper configuration for that landing – repositioned them as the narrowbody descended through about 500ft. But at an altitude of around 100-200ft, the aircraft was above the glideslope. According to data captured on the cockpit voice recorder, this prompted the captain to tell the co-pilot: "Get down".

About 3s from touchdown, at an altitude of 27ft, the pilot is heard to say "I got it", and shortly afterwards took control of the aircraft. However, the 737 hit the runway at a descent rate of 960ft/min and a nose-down pitch attitude of -3.1°, says the NTSB.

The captain's decision to take control of the aircraft at just 27ft "did not allow her adequate time to correct the airplane's deteriorating energy state and prevent the nose landing gear from striking the runway," says the NTSB.

Southwest requires that pilots initiate a go-around immediately if the aircraft's flaps or landing gear are not properly configured by the time the aircraft is 1,000ft above touchdown. ■



NTSB

The hard landing drove the nose gear strut into the electronics bay



Rex Features

TRAINING

Chengdu Airlines pilots get to grips with delayed ARJ21

Comac has commenced ARJ21 flight training activities with launch customer Chengdu Airlines, as it closes in on long-delayed service entry for the regional jet. The Chinese airframer says pilot training began during July using aircraft 105, which will be the first of 30 ARJ21s to be delivered to the carrier. So far, the airline's pilots have performed landings and take-offs, as well as missed approaches. Chinese type certification for the ARJ21 was received in December, but Comac has yet to gain a production licence. No firm delivery date is available for the initial aircraft, but the handover is still scheduled to take place this year. **See Feature P30**



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FUNDING **TOM ZAITSEV** MOSCOW

Sukhoi, Irkut set for further subsidy boost

Russia's government has introduced additional subsidies to support sales of the Sukhoi Superjet 100 and Irkut MC-21 airliners.

Funding from the national budget will be used to offset the United Aircraft subsidiaries' spending on a portion of their non-manufacturing costs.

"In turn, that should allow the producers of new mainline aircraft to lower their prices and help increase their sales by incentivising customers," says Russian prime minister Dmitry Medvedev.

Some Rb250 million ($4.4 million) will be allocated this year.

Sukhoi Civil Aircraft will initially be the sole recipient of these funds, says the trade and industry ministry, adding the subsidy to Irkut is pending the MC-21's entry into service. ■

COMPONENTS **ELLIS TAYLOR** SINGAPORE

Boeing seals 777X Japan parts deal

Boeing has formalised agreements with a consortium of five Japanese suppliers to produce large components for the 777X programme.

The latest agreement formalises a memorandum signed in June last year between Boeing, Japan Aircraft Development Corporation (JADC) and Japan Aircraft Industries (JAI) – the latter representing Fuji Heavy Industries, Kawasaki Heavy Industries (KHI) – and its subsidiary Nippi – Mitsubishi Heavy Industries, and ShinMaywa Industries.

Under the deal, the five Japanese companies will be responsible for producing around 21% of the 777-8X and -9X's components, including centre wing sections, pressure bulkheads, main landing gear wells, doors, wing components and wing-body fairings.



Boeing

Japanese firms will provide around 21% of the type's components

All five Japanese companies are already major Boeing suppliers, and have a large workshare on the current 777 family.

"The signing of this contract is an important milestone for JADC and JAI," says Shigeru Murayama, JADC chairman and KHI president. "The JAI companies are investing in new facilities and introducing robotic and other automated systems to ensure they deliver high-quality products on time every time."

To support the contract, Fuji is building a new assembly facility at its Handa plant for the production of centre wing sections.

First delivery of the GE Aviation GE9X-powered aircraft is scheduled for 2020. ■

DISPUTES **DAVID KAMINSKI-MORROW** LONDON

Cargolux stands firm on 'illegal' strike

Carrier talks of holding individuals liable for damages as union continues to insist management meets safety demands

In a sign that a row over safety is turning increasingly bitter, Cargolux is to seek compensation for the cost of industrial action which grounded part of its fleet on 23 July, after dismissing the strike as illegal.

It has accused the union involved, the LCGB, of deception after it published claims the airline was not implementing a number of safety analysis measures.

But the Luxembourg-based carrier, which operates a fleet of Boeing 747 freighters, has strongly rejected these allegations.

Group safety officer Mattias Pak points out that the airline's safety processes have been audited by IATA and the European Aviation Safety Agency.

It has implemented new European-wide policies centred on a "just culture", he says, and it has already made arrangements to restructure an internal incident review team.



AirTeamImages

A quarter of the carrier's 747-based operations were affected

Pak adds that the airline has a long-running safety-reporting system in place which it encourages personnel to use.

The strike affected about a quarter of Cargolux's operations and the carrier insists that the action was "in breach" of an obligation to refrain from measures which might compromise the current collective agreement.

Cargolux says that the industrial action was "unlawful", and that this view has been backed by a court order. As a result it plans to claim compensation for the disruption.

"All of [LCGB's] individual members could potentially be held liable for any damages," the airline states.

Cargolux says the union has been engaged in an "ongoing negative campaign", based on "misleading statements". It adds that this strategy is "deceiving" the public, Cargolux employees and even the union's own members.

LCGB describes the situation at the carrier – which is part-owned by China's Henan Civil Aviation Development & Investment – as "totally unacceptable" and calls for senior management to "respond constructively" to its list of demands. ■



USAF shoots down A-10 exports pitch
DEFENCE P21

ENHANCEMENT **CRAIG HOYLE** LONDON

UTAS sets sights on Raptor role after Tornado is retired

Company offers redesigned sensor pod for Typhoon to ensure continued capability for RAF

UTC Aerospace Systems (UTAS) hopes to close a possible future gap in the UK's tactical reconnaissance capability, ahead of the planned retirement of the Royal Air Force's last Panavia Tornado GR4s in 2019.

The Tornado can carry the UTAS-produced Raptor pod, which incorporates the company's DB-110 sensor, but this is too large in its current guise for integration with the Eurofighter Typhoon. As a result, UTAS is pursuing a smaller pod which could be used by the multi-role type, says Stephen Trimble, the company's director of processing, exploitation and dissemination technology systems.

"The studies show it will fit on Typhoon," he says of the new pod design. However, the integration of the DB-110 is not among currently-funded capability enhancements for the European type.

Further details of the UK's intelligence, surveillance and reconnaissance priorities are expected to be outlined in a new Strategic Defence and Security Review which will be released around October, but RAF commanders have said there will be no capability gaps left following the Tornado's retirement.



The DB-110 as carried by the GR4 is too large for use on the Eurofighter

Crown Copyright

Meanwhile, UTAS is further developing the DB-110 system's capabilities, with Trimble saying that a multi-spectral sensor "should be ready in the next year". The company also is working with Selex ES in the UK to integrate one of the latter's synthetic aperture radars using the same pod design. This would provide operators with an all-weather reconnaissance capability, he adds.

Around 70 DB-110 pods are in current use, with UTAS having sold the system to 11 nations. ■

SELECTION **DOMINIC PERRY** LONDON

Fuji/Bell team wins UH-X competition

Tokyo has selected a Fuji Heavy Industries/Bell Helicopter proposal for its UH-X requirement, which will deliver a new multi-role helicopter for the Japan Ground Self-Defense Force.

The partners are to develop a modified version of the Bell 412EPI medium twin-engined rotorcraft. Work is to start during the current financial year, and Bell expects deliveries to run over a 20-year period from 2021.

Japan could acquire as many as 150 UH-X aircraft to replace its existing land forces inventory of 130 UH-1Js, which were licence built by Fuji during the 1990s. The company is also likely to offer the platform to the export market.

Selection of the Bell 412-derived platform followed a competition also involving a Kawasaki Heavy Industries/Airbus Helicopters bid based on the latter's developmental H160 medium twin.

Japan's defence ministry says the Fuji/Bell offer outscored the rival bid in an evaluation of performance, delivery schedule and contributions to the nation's economy and technology base. ■



Rex Features

Japan's existing fleet of UH-1J helicopters is due for retirement

TRANSFER **ARIE EGOZI** TEL AVIV

Jordan receives surplus Cobras from Israeli ally

Israel has transferred 16 Bell AH-1 Cobra attack helicopters to Jordan to assist its air force in the fight against Islamic State militants, US sources confirm. The rotorcraft – which had been phased out by the Israeli air force – were refurbished prior to being delivered, the sources add.

The Israeli air force began operating AH-1s in 1975, before replacing the type with Boeing's AH-64 Apache. Surplus aircraft were kept in storage after the AH-1 was retired in 2013.

Foreign sources say that Israel and Jordan have been co-operating in the fight against Islamic State, largely through joint intelligence activities, but that this is the first transfer of weapon systems between the nations. Israeli, Jordanian and US officials declined to comment on the delivery, which could only have been made with Washington's approval.

Flightglobal's Fleets Analyzer database records the Royal Jordanian Air Force as having had 31 AH-1Fs in service prior to any additions arriving from Israel.

Separately, Argentina is negotiating the possible purchase of upgraded Israel Aerospace Industries Kfir fighters, after a long period of "preliminary evaluation".

Argentinian air force representatives visited Israel last year and were briefed about the proposed deal, which involves aircraft modified to a Block 60 configuration featuring an Elta Systems EL/M-2032 active electronically scanned array radar. The service then submitted a list of technical modifications that it would want to see incorporated ahead of a potential purchase.

Some Kfirs are being offered with General Electric J79 engines with zero hours following a complete overhaul, while others will need this work after the powerplant reaches 1,600 flight hours.

IAI declines to comment on the negotiations, which *Flight International* has previously reported could be for 18 aircraft. ■

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UNMANNED SYSTEMS **BETH STEVENSON** LONDON

Royal Navy tests unmanned vision with SULSA

A team from the University of Southampton has launched an unmanned air vehicle manufactured using 3D printing technology from the bow of a Royal Navy ship, demonstrating the potential of such platforms for short-range surveillance.

The Southampton University Laser Sintered Aircraft (SULSA) was launched via catapult from the patrol vessel HMS *Mersey* near Weymouth, Dorset, completing a 5min sortie over 500m with a lightweight video sensor.

SULSA is 1.5m (4.9ft) long and weighs 3kg (6.6lb). The university claims it is the first UAV to have been made entirely via 3D printing using laser sintered nylon. It consists of four separately manufactured main parts that are assembled without the need for additional tools.



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The 3D-printed UAV was launched from the service's HMS *Mersey*

Under the leadership of First Sea Lord Adm George Zambellas, the RN has increased its operational use of UAVs, including the Boeing/Insitu ScanEagle. The service's first unit dedicated to unmanned operations – 700X Naval Air Squadron, based at RNAS Culdrose in Cornwall – was established in December 2014.

"Our first squadron of remotely piloted aircraft proved their worth in the Gulf," Zambellas says. The SULSA trial will help the service explore how "simple, automated systems [can] replace complex machines", he adds.

Boeing said in July that its ScanEagle contract with the UK has been extended until 2017, and it will offer to extend this until a planned new UAV begins operations with the navy in 2022.

Meanwhile, a rotary-wing flight demonstration using AgustaWestland's optionally-piloted SW-4 Solo was recently carried out for the RN. ■

ORGANISATION
ARIE EGOZI TEL AVIV

Israeli squadron is established to receive F-35I

Israel's first Lockheed Martin F-35I (Adir) squadron will be officially established in early August, as the nation's air force advances preparations to take delivery of the type in early 2017.

"Receiving these aircraft is a pioneering move which also includes great uncertainty," the commander of the lead F-35I squadron, identified by the service as Lt Col Yotam, told the Israeli air force website.

"The challenges we will most certainly come across and deal with by ourselves will be translated into knowledge that will later be conveyed to other countries. We will gain a great deal of experience."

A second F-35I squadron is already planned, and the air force is examining the possibility of standing up a third unit. Israel has so far ordered 33 conventional take-off and landing F-35As, and has options on another 17. Squadron technicians are already studying the Israeli-developed systems that will be integrated with the fifth-generation fighter. ■

CAPABILITY **JAMES DREW** MCLEAN

'Combat cloud' takes form

Northrop proposes enhanced gateway product to safeguard battlespace communication

Northrop Grumman has expanded the capabilities of its Battlefield Airborne Communications Node (BACN), with the Enterprise Airborne Gateway Network (EAGN) promising to make so-called "combat cloud" warfare commonplace.

BACN was developed and fielded to relay beyond-line-of-sight voice and data exchanges between US and coalition forces in mountainous Afghanistan, with Northrop's EQ-4 Global Hawk and Bombardier's Global Express-based E-11A as platforms.

Speaking at its Centre for Innovative Solutions in Virginia, Northrop Grumman Information Systems president Kathy Warden said the product is derived from the baseline BACN, and that the company is eyeing applications for US forces operating in the Pacific region and Africa. It also is "talking to several US allies about the EAGN capability", she adds.

Northrop has not yet secured a launch customer, but the US Air Force is exploring a requirement for a highly redundant and secure airborne networking enterprise to bring its "combat cloud" concept to life. The French air force has a similar need.



US Air Force

BACN is currently installed on the Global Express-based E-11A

"It's about shared battlespace awareness and joint integration," says Rob Evans, director of business development for airborne command-and-control information systems. "BACN was designed to solve a very specific problem. It then evolved to perform other capabilities, like the linking of disparate networks."

Evans suggests several operational concepts for EAGN, most of which involve the RQ-4 Global Hawk, but also potentially the USAF's future Long-Range Strike Bomber. Applications could range from re-establishing communications across a battlespace to tracking ballistic missiles and acting as a surrogate satellite, he says.

Meanwhile, the USAF signed a research and development agreement on 14 July for Northrop to demonstrate its universal payload adaptor for the RQ-4B Global Hawk. The equipment will enable the unmanned type to carry various sensors currently integrated with the Lockheed Martin U-2 surveillance aircraft. ■



Legacy 500 gets Beijing validation
BUSINESS AVIATION P22

FLEET JAMES DREW WASHINGTON DC

USAF shoots down A-10 exports pitch

Service formally rejects Boeing-backed proposal to offer surplus ground-attack aircraft for operation by allied nations

The US Air Force has ended discussions about potentially transferring some of its Fairchild Republic A-10s to allies, and says it will not sell the ground-attack aircraft to anyone.

A Boeing official in late May triggered speculation about whether the US government would consider selling surplus aircraft, by revealing that there had been "early discussions" about international sales.

In a 23 July statement, the air force confirms: "There are no anticipated sales of A-10 aircraft to anyone."

The move quashes any hopes that Boeing might have had about upgrading and sustaining the aircraft for a foreign owner, as the USAF would prefer to send its entire fleet to the "boneyard" as part of a sequestration-prompted strategy that is expected to save about $4.2 billion over five years.



US Air Force

The air force expects to save $4.2 billion by retiring the Warthog

Boeing is most of the way through a multi-billion dollar re-winging programme that will extend the life of the A-10, and says it would be cheaper for the air force to complete the upgrades than break that contract at this point.

Despite being described by Air Combat Command chief Gen Herbert Carlisle as the "best close-air-support aircraft ever", the USAF has been on a campaign to retire the "Warthog" fleet. The service argues that it lacks the funds to keep the ageing aircraft operational, and says it also needs to free up maintainers to support the Lockheed Martin F-35.

Congress continues to oppose the retirement plan, but has permitted the USAF to transfer some of its aircraft into "type 1000 storage", which preserves them in near-flyaway condition. Some 21 of the 140 A-10s now at the 309th Aerospace Maintenance and Regeneration Group at Davis-Monthan AFB in Arizona are in this condition, the USAF says. ■

TRAINERS CRAIG HOYLE LONDON

Grob grabs attention from another three countries

At least three more nations are considering acquiring Grob Aircraft's G120TP turboprop trainer, the company says.

With deliveries already made to Argentina, Indonesia, Mexico and Myanmar and the type also selected to meet requirements in the UK and the USA, further opportunities are now being pursued in Latin America and Asia.

Speaking to *Flight International* at the Royal International Air Tattoo in the UK on 18 July, vice-president of business development Guillermo Christ said Taiwan is "very interesting" for the company, with a potential requirement for between 25 and 30 aircraft.

Ecuador is also looking to acquire 15 new trainers, with an order expected during 2016. "They are asking for information," Christ confirms. Flightglobal's Fleets Analyzer database records the nation's air force as currently flying nine aged Cessna T-34Cs. A 10-aircraft order from Paraguay could also be confirmed "soon", he says.

Meanwhile, existing operator Mexico could look to double the size of its current order, to 50 units, and Indonesia is reported as having already increased the size of its fleet from 18 to 24 examples.

Grob Aircraft's production capacity will allow for the delivery of up to 50 G120TPs per year.



Grob Aircraft

Ecuador, Paraguay and Taiwan are all interested in the G120TP

The side-by-side-configuration aircraft has so far been available with a choice of either an analogue or digital cockpit, but Christ says the company is now looking to offer only the latter. "We highly recommend the digital cockpit, as operators will be using this aircraft for the next 15 or 20 years," he notes. ■

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AIRWORTHINESS
DOMINIC PERRY LONDON

De-icer directive issued as Super Puma overheats

Operators of a number of Airbus Helicopters Super Puma variants fitted with certain tail rotor de-icing systems have been advised to check the condition of the equipment, following an incident during which blades were left damaged following overheating of the unit.

The European Aviation Safety Agency says that in certain conditions the de-icing system on the AS332's C, C1, L and L1 models can inadvertently be turned on while the aircraft is on the ground without its rotors turning.

In such situations, says EASA in an emergency airworthiness directive, the crew may be unable to detect "fumes or smells" coming from the tail rotor "and… possible damage [to] a tail rotor blade".

This in turn could "lead to structural damage of tail rotor blades resulting in significant vibrations and reduced control of the helicopter".

"The condition could lead to structural damage of tail rotor blades, significant vibrations and reduced control"
EASA

EASA says the overheating incident that triggered its warning took place following operation of the de-icing system in flight and subsequent use of a ground power unit (GPU) with the helicopter.

Analysis suggests a failure of a power supply box led to the inadvertent activation of the system while on the ground.

It advises that inspections of the rotor blades take place whenever the de-icing system has been activated – whether in flight or as a ground test – and a 115V/400Hz GPU applied. ■

EXPANSION KATE SARSFIELD LONDON

VistaJet widens its horizon

Swiss VIP charter company ready to offer internal flights in China using Challenger 850

VistaJet will begin offering point-to-point services in mainland China in August, using a B-registered Bombardier Challenger 850 business jet.

The Swiss VIP charter company has joined forces with Apex Air, headquartered in Nantong, Jiangsu province, and will manage the service on its behalf.

"We have been flying in and out of China for seven years, but we haven't been able to fly internally until now," says VistaJet's chief operating officer, Ian Moore.

The advantages of operating B-registered aircraft within the country are numerous, and include the considerable benefit of access to more airports and landing slots than internationally registered carriers.

"This venture with Apex enhances our offering," Moore says. "The Challenger 850, with its large cabin and transcontinental range [of 2,800nm (5,200km)] is ideal for this market."



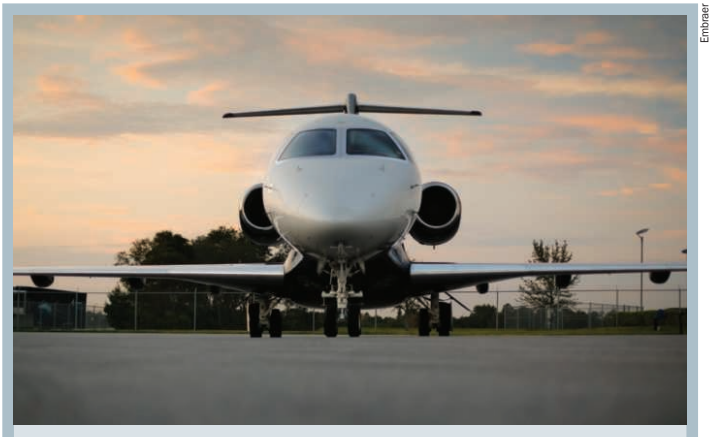
VistaJet
Nantong-based Apex Air will manage the point-to-point service

The service has received an enthusiastic welcome, which Moore attributes to the country's current climate of austerity. "With our service, clients can travel anonymously. You can't do that if you own your own aircraft," he says.

VistaJet expects the Chinese market to grow by around 30% in 2015 and it plans to add another Challenger 850 to the B-register at the end of the year.

"If there is even more demand, we will push for extra aircraft," Moore says.

"There are typically six VistaJet aircraft flying around Asia at any given time. But we could position all 53 of our aircraft there, if required." ■


Embraer

APPROVAL

Legacy 500 gets Beijing validation

Embraer secured Chinese validation for the Legacy 500 on 24 July, and is now preparing to deliver the first midsize business jet to Chinese launch customer and ambassador of its executive jets division, Jackie Chan.

The 10-seat twinjet entered service late last year and Embraer had shipped 14 of the type by the end of the second quarter, according to Flightglobal's Ascend Fleets database.

While the USA is – and will continue to be – the largest market for the Legacy 500, Embraer expects the aircraft to become popular in China, despite a preference for long-range and large cabin types in the country.

REPRESENTATION

Gulfstream to boost sales in Latin America

Gulfstream is beefing up its sales team in Latin America with the appointment of Chilean business aviation services provider and G150 operator Aerocardal as sales representative for the country.

"There are now more than 180 Gulfstream aircraft in service in the region," says senior vice-president of worldwide sales and marketing Scott Neal.

Mexico has the largest installed base of Gulfstream types in the region with a fleet of over 60, followed by Brazil.

"In the past five years, Gulfstream's fleet in Latin America has grown nearly 70%," the manufacturer says. "The continent now represents about 8% of our worldwide fleet." ■

See Feature P34



Why Airbus wants to make mistakes in Silicon Valley
NEWS FOCUS P24

DEVELOPMENT **STEPHEN TRIMBLE** OSHKOSH

MVP says tri-hull amphibian is worth hanging around for

Developer extends certification target due to limited funding, but touts unique features

Start-up seaplane builder MVP Aero is adding undisclosed but "exciting" new features below the water line of its tri-hull amphibious aircraft, says director of digital marketing and co-founder Michael Lynds.

"Below the water line there's a lot of exciting engineering that you won't see on any other planes, and it's arguably as exciting as above the water line," Lynds says. "But because of that it's patent-pending."

MVP launched the eponymous, two-seat seaplane a year ago at the Experimental Aircraft Association's annual fly-in in Oshkosh, Wisconsin.

The $189,000 aircraft was pitched at the same market that has shown so much interest in the similarly-priced Icon Aircraft A5, which is now in production.

But MVP made the aircraft's versatility a key point in the design, with a foredeck that can be used as a fishing platform and a tail boom sized to accommodate a hammock between the vertical tail and the engine block.

The launch event included key sponsors, such as former Cirrus executive Alan Klapmeier.



MVP Aero

A hammock can be slung between the tail and engine block

Since last January, the programme has made steady progress, completing the design engineering work, Lynds says. But the pace of work is being held back by a lack of timely funding support.

The company is ready to begin building a flying prototype, but must wait to receive a new round of financial investment.

"Funding dictates everything. If we had full funding we'd be out of the gate and in production in three years," Lynds says. "Funding is coming in waves and not all at once, which kind of stretches it a little bit."

A timeline released at the event a year ago predicted the MVP would be certificated as a special light sport aircraft by 2019.

"Maybe push that back six months to a year," Lynds says. ■

SEAPLANE **STEPHEN TRIMBLE** OSHKOSH

Akoya's 'tricky' landing gear revised

A production-conforming prototype of the Lisa Akoya will enter production next year featuring a redesigned landing gear, the France-based manufacturer says.

The two-seat amphibian will retain its classic taildragger configuration, with a small tailwheel behind the main landing gear under the cockpit.

However, the original landing gear system was said to be "tricky" to manoeuvre on runways, so will be improved with increased damping.

The landing gear tweak is among the last design changes as Lisa prepares for a year-long certification campaign.

The company's goal had been to obtain a special-light sport aircraft certificate in the USA for the Akoya in 2016. This would be followed by a CS-LSA certification in Europe.

But the schedule has slipped slightly, into early 2017 for the US certificate, and later still for the European approval.

The company launched the programme with a proof of concept aircraft in 2007, and an early production prototype started flying four years later. That model included several changes, including one intended to offset a sharp pitching moment when the single-engined aircraft accelerated in water.

Lisa's engineers added a control surface to the horizontal stabiliser, which functions like a trim tab to automatically offset the pitching moment as the thrust is increased.

The aircraft still has about 100 reservations and commitments for orders, the company says, with most of the demand coming from the USA and Europe. ■

ENGINE **KATE SARSFIELD** LONDON

Rotax addition extends family's potential reach

Austria's BRP-Powertrain is expanding its Rotax family of piston engines with the launch of its turbocharged 915iS.

The four-stroke, four-cylinder powerplant is designed, says the Gunskirchen-based company, to help it expand its share of the general aviation aircraft market beyond the ultra-light and light-sport aircraft sectors. BRP's Rotax engines currently dominate these, powering over 80% of the fleets.

"The 915iS opens the way for larger, heavier aircraft and even small helicopters," says company vice-president and general manager Thomas Uhr.

The 135hp, turbocharged 915iS is a follow-up to the three-year-old 912iS. It features a reinforced crankshaft, newly designed pistons and a turbocharger. To handle the higher torque, the 915iS will also feature a new gearbox. ■

ACQUISITIONS

Cessna lands China orders

Cessna secured two sizeable orders from Chinese customers at the AirVenture show in Oshkosh, Wisconsin, in late July.

Shanghai-based operator Joy Air acquired 20 Grand Caravan EX amphibians for its regional air tour operation. The single-engined turboprops – equipped with Wipaire's Wipline 8750 floats – will be built at the Cessna-AVIC Aircraft facility in Shijiazhuang, Heibei Province. Deliveries are scheduled to begin later this year.

Shandong Hairuo General Aviation placed a follow-on order for six Skyhawk 172 piston singles.

Its first contract – for two of the six-seat, high-wing aircraft – was signed in April. The Garmin G1000-equipped 172s will be used by the Binzhou-based company and Cessna's local sales representative for commercial pilot training. ■



STRATEGY **STEPHEN TRIMBLE** WASHINGTON DC

Why Airbus wants to make mistakes in Silicon Valley

Toulouse is investing heavily in California's high-tech hotbed of innovation in order to accelerate its development projects

If failing correctly can be considered a strategic business skill, Silicon Valley may have a lot to teach the aerospace industry – most recently Airbus Group.

Over the past five months, Airbus has sunk roots into the heart of California's booming high-tech economy, setting up a $150 million venture capital firm, launching a Defense Advanced Research Projects Agency (DARPA)-like technology incubator and poaching two of Silicon Valley's elite entrepreneurs to run them.

Silicon Valley's attraction for all three Airbus divisions goes deeper than the stream of new technologies and ideas flowing into the consumer electronics market. Airbus also wants to co-opt the way that Silicon Valley's firms develop technology – and a key characteristic of the Silicon Valley model is how it deals with failure.

CONCEPT INCUBATOR

"We're really excited about what's happening in Silicon Valley," says Ken McKenzie, deputy chairman and senior vice-president of strategy and corporate services for US-based Airbus Group Inc.

"It happens fast," he says. "If it doesn't work they move on to something else very quickly, instead of beating a dead horse for years before saying 'this doesn't work, so let's shut down this multi-million dollar project.'"

After Airbus Group chief executive Tom Enders made an exploratory visit in March, the company announced the formation of two new companies in late May. Airbus recruited former Google advanced projects and DARPA executive Paul Eremenko to head the tentatively-named Innovation to Business centre – an incubator of very long-term technologies and concepts.

Tom Dombrowski, a veteran of the Andreessen Horowitz venture

DESIGN

The 20-year plan: to bring hybrid-electric propulsion to a 100-seat regional airliner

In less than two decades, Airbus's concept for the VoltAir E-Fan could spawn a new family of 100-seat regional airliners with a hybrid-electric propulsion system anchored by diesel engines sending 6MW of power to a row of electric thrusters.

The potential 100-seat aircraft is still early in the design phase, but Airbus already appears to be leaning toward a familiar configuration.

"We're starting to work on the design of what we call the EPU," says Ken McKenzie, deputy chairman and senior vice-president of strategy and corporate services for US-based Airbus Group Inc. "We're actually preferring a hybrid engine."

McKenzie links the Airbus design to the NASA N3-X concept that emerged about five years ago, revealing a blended-wing body with gas turbine engines generating electricity for a row of electric thrusters buried in the boundary layer flow along the trailing edge of the fuselage. "It may not be a gas turbine in our case", he says. "It may be diesel."



NASA

NASA's N3-X concept used a blended-wing body and gas turbines

COMMERCIALLY VIABLE

A particular concern that arose about the N3-X was the amount of shielding required to protect passengers from the spillage produced by the semiconductors, which would transfer the power generated by the engine to the thrusters. McKenzie says that issue will have to be addressed in the Airbus design as well.

Airbus has previously discussed the hybrid-electric 100-seater as a 10-year goal, but McKenzie sets that timetable back by almost a decade. "I think it's a 2032 time window for a commercially viable aircraft," he says.

The concept leverages Airbus's plans to introduce an electrically-powered, two-seat trainer in 2017 called the E-Fan 2.0 and a four-seat, hybrid-electric 4.0 model afterward. The company on 10 July flew an E-Fan demonstrator 40nm (74km) across the English Channel to showcase its electric propulsion concept.

The hybrid-electric system for the E-Fan 4.0 is expected to provide critical information for Airbus engineers working on the 100-seater. The propulsion for the four-seater will have an unusual configuration, with a single engine driving two electric fans, McKenzie says. If the concept resembles the propulsion configuration for the 100-seater, it raises intriguing questions, such as how Airbus would compensate for excess yaw if one of the fans stops working.

"You have one motor, but you have two thrust-producing devices," he says. "The asymmetric thrust has to be almost zero, so if you lose one it can still fly on the other. One of the concepts we had was if you lose one the other one stops too." ■



An E-Fan demonstrator flew across the English Channel to prove the potential of electric propulsion

Rex Features

capital firm known for specialising in social media platforms, also has joined Airbus Capital Ventures, which will focus on investing in mature products.

Both Eremenko and Dombrowski are busy hiring staff and developing operational plans. The organisations should be established by October and the first funded projects should emerge by the end of the year, McKenzie says.

ADVANCED AEROSPACE

Some well-known Silicon Valley brands have already invested heavily in advanced aerospace companies, such as Google's launch of the unmanned Project Wing package delivery service, and the acquisition of Vern Raburn's high-altitude, solar-powered unmanned air vehicle called Solara.

But Airbus has a different set of expectations for its Silicon Valley ventures.

"In our Silicon Valley initiative, I don't expect to see a single new [manned] airplane ever come out of it," McKenzie says. "What I do expect are [new ideas like] connected cabin, UAVs. You can do fast-fail for UAVs. You do those quickly and innovatively while using some of the disciplines from airplanes and helicopters, but not tainting it so much that we need to get this Six Sigma-level [quality] before we can let this thing fly. We can just give it a try."

Speaking to Flightglobal at the Experimental Aircraft Association's AirVenture fly-in in Oshkosh, Wisconsin, McKenzie compared the Silicon Valley method to the community that builds aircraft kits and new designs at their homes. The goal of the Airbus Innovations office – managed by chief technical officer Jean Botti – is to take a similar approach with its own portfolio, but that requires a sharp break with current practice.

"We're very staid," McKenzie says. "We come up with the design, we come up with the strategy, then come up with the project management, go through all the gates, and eventually by the time you put it out there the need for it is gone and your competitors are so far [ahead] that you're dead in the water with some of these new ideas."

> **"Are we going to drive around Mars in rovers? Or are we going to fly? We think we're going to fly."**
>
> **KEN MCKENZIE**
> Deputy chairman, Airbus Group Inc

The Silicon Valley initiative follows a string of external investments by Airbus in cutting-edge aerospace technologies, including a partnership to help Aerion develop a supersonic business jet. Another such project, the Airbus-branded Perlan II, was on display at the AirVenture event. The Perlan team is seeking to shatter the high-altitude record for glider flight, soaring to higher than 90,000ft using a mysterious weather phenomenon called the polar night jet.

It may seem unusual that Airbus is investing in an unpowered, high-altitude glider – but there is a strategy, McKenzie says. Airbus Defence & Space has interests in suborbital spaceflight, and also in the very long-term in the exploration of Mars.

"At 100,000ft [above Earth] you've got the same atmospheric conditions as Mars," he says. "You think we're going to drive around [Mars] in rovers? Or are we going to fly? We think we're going to fly. So we have a project that we've worked on, which is a spaceplane.

"And now we can actually test stuff, because we can put it on the Perlan. They're all excited because they're getting the record. We're all excited because we're proving the concept."

EXTERNAL IDEAS

Airbus is not the first aerospace company to take notice of Silicon Valley's innovation prowess. In 2011, Boeing Military Aircraft chief executive Chris Chadwick talked about leveraging Apple's innovative product development process to design the next fighter or trainer.

But Airbus is the first to physically set up shop in Silicon Valley – a move that fits in with the company's greater openness to external ideas.

"On the one hand, Airbus gets better leverage, a broader portfolio and less risk," says Teal Group vice-president and aerospace consultant Richard Aboulafia. "On the other hand, the history of identifying promising technology is not good. I have three words for you: Connexion by Boeing." ■



Airbus

The Perlan II project seeks to break the high-altitude record for glider flight by soaring to 90,000ft



MIDDLE RIDDLE

The industry has not been short of fresh propulsion programmes in recent years, but none cover the likely thrust range for a much-talked-about Boeing 757 replacement

STEPHEN TRIMBLE WASHINGTON DC

By the end of the decade, a remarkable six clean-sheet commercial aircraft engines spanning two generations of propulsion technology are expected to enter service.

That long parade of fleet introductions – sporting all-new propulsion brands such as GEnx, Trent 1000, Trent XWB, PW1000G, Leap and GE9X – are aimed either at replacing decade-old families of engines reaching the end of their production life, or occupying gaps in thrust levels ranging from 14,000lb (62kN) to 105,000lb.

In that incredible diversity, however, is one significant omission. Nothing currently in development or recently transitioned into production falls within the range of 40,000lb to 60,000lb.

That glaring gap may soon have to be addressed. Boeing is studying what it calls a "middle of the market" (MOM) aircraft concept, potentially replacing 757s and 767-200s with a new aircraft starting around or after 2025. The concept could still be more than a year from a launch decision, but Boeing has loosely defined the configuration as a new aircraft with widebody comfort and narrowbody economics that can carry up to 220 people as far as 5,000nm (9,260km).

> **"We've been running fast at Rolls-Royce over the last 15 years"**
>
> **TONY WOOD**
> President of aerospace, Rolls-Royce

Such an aircraft could require Boeing's engine suppliers to launch yet another new centreline engine. In June, GE Aviation chief executive David Joyce said the MOM aircraft design would require a new clean-sheet engine in a thrust range between 40,000lb and 50,000lb, representing a billion-dollar investment needed to develop and certificate another commercial engine.

"If you take a look at it, we don't have an engine in the portfolio that fits this thrust class, as I understand," Joyce said. "So, will it take a new development programme? Yeah."

That places the MOM thrust requirement in a category that entered development in the late 1960s, then battled for orders and positions on the next decade's great widebody rivals, including the Boeing 747, the Douglas DC-10, the Lockheed L-1011 and the Airbus A300. Two generations of engine families – bearing the brands JT9D, CF6, RB.211, PW2000, PW4000 and Trent 700 – were developed to power a wide assortment of narrowbodies and widebodies, including Boeing's 757 and 767 and the Airbus A330.

BURN REDUCTION

Even as widebody thrust requirements tilted to the category over 60,000lb, GE and Pratt & Whitney alone have combined to deliver more than 10,000 engines in the middle of the market range over a period of nearly five decades. With the technology for the majority of engines in this class now decades old, it should be possible for the engine manufacturers to deliver a substan-



The 757 features 1980s technology, so a new design could achieve significant performance improvements

Airteamimages

tial reduction in fuel burn with a propulsion system entering service in another 10 years.

"The 757 had early 1980s technology, so if we're talking about a 2025 aircraft, one would expect very significant [specific fuel consumption] improvements," says Flightglobal Ascend senior consultant Richard Evans. "People used to reckon on anywhere from 0.5% to 1% per annum improvement in SFC or fuel burn at the aircraft level, so perhaps engines would have anywhere from 20% to 45% lower SFC."

There are still many questions hanging over Boeing's conceptual airframe. For example, could the new aircraft be as wide as a 767 or even larger, or could it fall between the width of a 757 and a 767 like the cancelled (and smaller) 7J7 concept from the 1980s?

Similar mysteries also exist for the engine architecture. P&W's heavy investment in geared turbofan narrowbody engines, which are scheduled to enter service next year on the Airbus A320neo, has generated strong interest around the industry, with Rolls-Royce also investing heavily in geared-engine technology and GE Aviation acquiring gear specialist Avio.

Most engine company executives are keeping their plans for a MOM concept engine closely held, but P&W vice-president of technology and environment Alan Epstein is at least willing to make one bold prediction. Asked during a press conference in June how P&W could respond to Boeing's MOM concept, commercial engines president Greg Gernhardt attempted to be as broad as possible in his reply. "There are a lot of people talking to us about the gear," Gernhardt said. "And, you know, the PW1000G series of engines has a lot of leg room for future growth. We're busy talking about a lot of opportunities."

Then Epstein spoke up: "Let me add something. Whomever makes the next airplane, I will predict it will have a geared engine on it. In fact, I will even take money on that."

GEARED ALTERNATIVES

A reporter asked if Epstein was offering the bet because he knew that his competitors were working on geared engine alternatives to the PW1000G series. "I didn't say it wasn't a sucker's bet," Epstein replied.

Epstein's competitors at R-R have made it no secret that a geared architecture and improvements in thermal-cycle efficiency are the key technologies now being developed for the Advance, an engine being prepared for service entry after 2020. An even more advanced concept dubbed the "UltraFan" would add more exotic upgrades, such as variable-pitch fan blades to optimise air flow.

In a June press conference, R-R president of aerospace Tony Wood explained the company's approach to a MOM aircraft requirement. Viewing the fragmenting of the narrowbody market as a long-term trend – with the emergence of the Bombardier CSeries and Embraer E-Jets overlapping with the Airbus and Boeing narrowbodies – R-R has focused investment in engine technologies that can swing between market categories.

> **"The PW1000G series of engines has a lot of leg room for future growth"**
>
> **GREG GERNHARDT**
> Commercial engines president, P&W

That is "why the Advance and UltraFan have technologies that we can scale and apply to aircraft in different sizes in that market", Wood says.

"We've been running fast at Rolls-Royce over the last 15 years developing a new engine every few years," Wood adds. "We're now at a period where with the strength of our orderbook we're now in a demonstrator mode with those technologies, and making sure we can develop them fast enough to be ready to play on whatever options come."

Wood also thanked a journalist for describing Boeing's new concept as a "middle of the market" aircraft, noting that it should not be viewed as another narrowbody programme.

Eric Schulz, president of R-R's large engine programmes, points out that Boeing's strategy for addressing the MOM concept plays to his company's strengths in the widebody engine sector. The strength of the A321 order book indicates a "clear shift" in demand for larger aircraft in what is usually called the middle of the market, Schulz says.

"We expect a natural translation to what we call the high end of the middle of the market into the widebody [category], and, looking forward, that's probably why some of the airframers – Boeing, in particular – is looking at what we in the industry call a replacement for the 757," Schulz says. ■



Rolls-Royce

R-R has been testing its CTi fan system using the Advanced Low Pressure System demonstrator



XWB-97 testing has passed the 1,000 cycle mark

Rolls-Royce

RELISHING A WIDER REMIT

As it prepares for a first flight of the A350-1000's Trent XWB powerplant, Rolls-Royce is enjoying an increasingly fruitful relationship with Airbus

MURDO MORRISON DERBY

A year after it powered to life for the first time in a concrete-walled test cell, the engine for the largest variant of the Airbus A350 will any day now be departing Rolls-Royce's factory in Derby, and making its way by road and sea to Toulouse, where it is set to make its maiden sortie on Airbus's A380 flying testbed, most likely in October, according to Airbus. Six to nine months and 120h of testing later, the Trent XWB-97 – exclusive powerplant for the A350-1000 – should fly on that aircraft for the first time, ahead of the type's service entry in 2017.

Meanwhile, with ground testing set to continue for another 12 months or so on seven other development engines, R-R will around the fourth quarter of next year add the higher-powered engine to a production line that is already ramping up output of its XWB-84 sibling. The XWB-84 (the designations reflect maximum thrust in thousands of pounds) exclusively powers the smaller A350-900, which entered service with Qatar Airways at the beginning of the year. Vietnam Airlines became the second operator in recent weeks.

OUTPUT INCREASE

R-R is currently producing two XWB-84s a week – although this has been raised to four to test the robustness of the production process and supply chain, says Tim Boddy, head of marketing for the programme. Both suppliers and final assembly line, he says, coped well with the exercise. He expects output to rise to five a week by the end of 2017 – including by then one example of the -97 variant – and to reach seven a week across the two variants by 2020. "One of our key challenges this year is the customer build-up on the -84," he says.

Boddy says he and his colleagues are "delighted" with the performance so far of the engine on the first A350-900s. There are now five of the twinjets in service with the two operators – Latam and Finnair will join their ranks shortly – and the XWB-84 is experiencing "very intense operations for a new engine", he says. "Vietnam are doing two-hour legs with up to six flights a day, while Qatar does a lot of medium-haul flights and operates in a challenging environment, with lots of flying through sand."

Although Boddy says "the -84 was always designed with growth potential", you would have to be a bit of an expert to spot the differences between the XWB-84 and the final production version of its big sister. One of the main tweaks is to the design of the fan system, which includes an inflected annulus to improve flow. "For the -97 we need to run the fan faster, so we've added material to the fan blade, the disc

"For the -97... we've added material to the fan blade, the disc and the fan case"

TIM BODDY
Head of marketing for Trent XWB, Rolls-Royce

and the fan case to cope with that higher stress," he says. A shroudless blade system has also been introduced for the first time on a Trent.

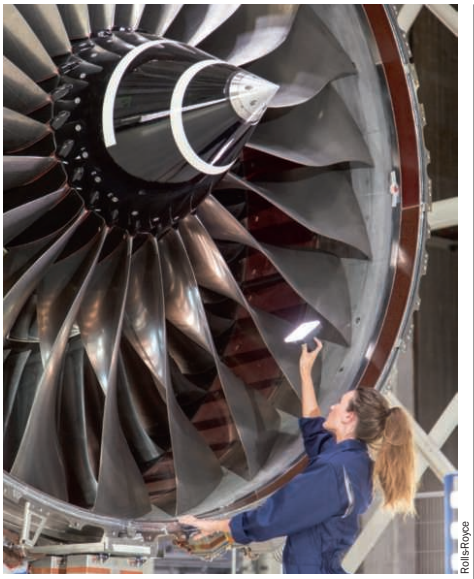
However, the nacelle is identical and most of the changes are deep within the engine. To achieve higher flow, and thrust, engineers have had to design a way to drive the core faster, and that has involved an increase in size of around 5%. "It's a subtle change but it's important to manage down design temperatures," says Boddy. "When you are driving up the engine temperature, the trick is to run it hot, reliably and with the minimum amount of cooling air. By adding high temperature technology, and adding size to the core, these two things together give you a very robust machine."

TEST MILESTONE

R-R will build eight XWB-97 development engines in total and has run five of them. The test programme has just passed the 1,000 cycle milestone with the company claiming "good results so far" and "high confidence in achieving all our targets". On 25 June, the engine completed a 150h endurance test that included more than 16h at maximum take-off thrust and 42h 30min at maximum continuous thrust. Meanwhile, development engine 20023 is at the company's Stennis test facility in Mississippi, USA preparing to have its ability to handle fan flutter and cross-winds scrutinised.

Another engine at Stennis – 20026 – will be used for cyclic testing, while a rebuild of development engine 20021 is taking place after that example underwent bird ingestion and rain and hail tests. The flight testing on Airbus's MSN1 A380 is designed to fine-tune powerplant integration and "de-risk" the flight test programme on the A350-1000, expected to begin around the third quarter of next year, says Boddy. Testing in 2016 and 2017 will focus on "maturity testing".


Rolls-Royce


Rolls-Royce

Five development XWB-97s have run so far

Later this year comes another first when the Trent XWB-97 takes to the air on the A380 flying testbed. It will be the only R-R product so far to include a major structure built using additive layer manufacturing (ALM), so-called 3D printing: the 1.5m-diameter titanium front bearing housing (*Flight International* detailed the initiative in our 3-9 March issue).

Production versions of the XWB-97 are not expected to include any ALM-built parts. However, the effort is part of a drive to introduce a host of innovations to improve the efficiency of its Trent engines. These are wrapped into its two major engine development studies – Advance and UltraFan – unveiled last year.

CLOSE RELATIONSHIP

With Airbus sitting on a backlog of more than 780 orders for the A350, including around 170 for the larger variant, the Trent XWB is R-R's most important programme in terms of numbers and reinforces the growing closeness of the UK firm's relationship with Toulouse. R-R has the field to itself with the repowered A330neo, for which it is developing the Trent 7000, and there is increasing speculation that it may launch an engine at November's Dubai air show to exclusively power a "Neo" version of the A380 – it competes with Engine Alliance on the current superjumbo.

However, while the success of the Trent XWB, the Trent 7000, and possibly a "Trent 9000" if that programme goes ahead, depends largely on Airbus's ability to secure orders, R-R is in a pitched battle with rival General Electric's GEnx on the Boeing 787. So far, the GEnx has a market share advantage in orders and deliveries of almost three to two over the Trent 1000, but R-R believes it is gaining momentum and that the latest Trent 1000-TEN variant, due to enter service in the second half of next year, will give it a technological and efficiency edge over its competitor.

In the next few years, R-R could possibly be equipping every Airbus widebody being built – subject to the launch of an exclusively Trent-powered A380neo – with a significant share on one of Boeing's two new twin-aisle families.

Although the firm has had its shareholder battles in recent years, and faces challenges meeting its strategic objective of breaking back into the narrowbody market in the 2020s and maintaining a presence in business jets, the Trent XWB in particular will ensure it a dominant footprint in the twin-aisle segment well into the next decade. ■



Airbus

Vietnam Airlines recently became the second operator of the XWB-84-powered A350-900

POWER PLAYER?

China's propulsion development has often been overshadowed by an airframe focus, but things could be set to change as engine programmes move up a gear

RICHARD FISHER WASHINGTON DC

There should be little doubt that China's aerospace ambition is to compete globally with leading aircraft makers such as Boeing and Airbus, and then to compete in the technically rigorous commercial large high bypass turbofan (HBT) market. While gaps in data abound due to China's pervasive secrecy, it is increasingly clear that Beijing's ambitions are being matched by broad investment in both commercial airframe and engine technologies. At the same time, it is pursuing potentially radical rationalisation of its engine sector.

As China nears completion of its first narrowbody, the 150 seat-class Comac C919, it has already started development of its 300 seat-class widebody, called C929. If Russia's President Vladimir Putin gets his way, the latter could become part of a joint China-Russia widebody airliner around 2025, followed by a co-developed engine.

China's development of modern commercial turbofans will lag behind that of its new commercial airliners, but perhaps not by much. The C919 may start flying with the CFM International Leap-1C in 2016, but could have the AVIC Commercial Aircraft Engine Corporation (ACAE) CJ-1000A by 2022. The C929 will also begin with a Western engine, but could receive the CJ-2000 by 2030.

One reason for this lag is that since the mid-1980s, China's top priority has been to develop modern turbofans for combat aircraft. Its development of modern HBTs has been a derivative of this effort, though by early in the last decade they appear to have gained a steadily higher policy priority. This, in turn, was spurred by the late 1990s decision to proceed with the development of heavy cargo transport aircraft and then airliners.



Comac

The C919 will initially fly with the Leap-1C

In recent years, as China's leadership under Communist Party Secretary General Xi Jinping has embraced the policy mantra of the "China Dream", which includes eventual global superpower status, it has also understood that its aerospace ambitions are hobbled by the lack of what they refer to as the "Chinese Heart", or modern aircraft engines.

WESTERN DOMINANCE

China's current dependence on Western engines is near total. In an April 2015 press release on its 30 years of business in China, CFM noted that China had ordered 3,900 CFM56 and Leap turbofans to power 1,950 Boeing and Airbus narrowbody airliners. China's widebody airliner fleet relies almost entirely on General Electric, Pratt & Whitney, Engine Alliance and Rolls-Royce.

As of June, Comac had orders for more than 500 Leap-1C-powered C919s, mainly from Chinese customers.

China not only wants to break the foreign monopoly over its own engine market; it also hints it has set its sights on eventual foreign sales. At the May 2015 China Aerospace Propulsion Technology Summit, it was reported that China may require 10,000 turbofan engines over the next 20 years, worth $98 billion. At the previous summit in 2014, ACAE offered its own global engine market projections. Over the next 20 years, ACAE projected a world requirement for 20,555 engines for widebody airliners, 45,777 for narrowbodies and 7,840 for regional airliners.

China's quest for modern HBTs can be divided into three phases. First, China used its established collection of state-controlled aviation companies plus attendant research institutes under the aegis of the Aviation Industries Corporation of China (AVIC), whose predecessor organisations date to 1951. Until recently, turbofan design and manufacturing concerns have typically been subordinate to aircraft makers.



AVIC Guizhou-Liyang Aero-Engine Group has been developing an engine that could eventually power the ARJ-21

As such, the AVIC Shenyang-Liming Aero-Engine Group produced engines designed by the AVIC Shenyang Engine Design and Research Institute for aircraft from the Shenyang Aircraft Corporation. The AVIC Xian Aero Engine Group made engines for the Xian Aircraft Corporation. The AVIC Chengdu Engine Group made engines designed by the AVIC Chengdu Gas Turbine Research Institute for the Chengdu Aircraft Corporation.

While such redundancy suited the guerrilla



Rex Features

war priorities of the Mao Zedong era, it has prevented the development of modern integrated companies capable of design, production and technology development.

Nevertheless, this model has yielded some new turbofans. Perhaps the most impressive performer from the distributed model has been the Shenyang-Liming Aero-Engine Group. In the late 1960s it developed prototypes of a high bypass derivative of the WS-6 fighter turbofan for a new transport aircraft, both of which were cancelled by Mao.

From the mid-1980s and commencement of Shenyang-Liming's WS-10A Taihang fighter engine programme (WS is short for woshan – "turbofan"), there has been an associated effort to develop HBT and marine turbine derivatives. Shenyang-Liming exploited the core of some of the first CFM56 turbofans China obtained in the mid-1980s to help design the Taihang.

Today, Shenyang-Liming's 24,000-26,000lb-thrust (107-116kN) "WS-20" – perhaps more recently designated WS-118 – is the only indigenous Chinese HBT flying today. It has been seen on a Russian Ilyushin Il-76 engine testbed aircraft since early 2013. Galleon Consulting of Shanghai reported it would start production in 2015, but this has probably been delayed. The WS-20 is expected to succeed the 24,000lb-thrust Soloviev D-30KP-2 turbofans currently used by the Xian Y-20 heavy military transport. Chinese reports indicate there may be a 32,000lb-thrust WS-20 in development.

When it was revealed at a Shanghai exhibition in November 2009, multiple Chinese reports noted that the 26,000lb-thrust "SF-A" was the civilian/commercial version of the WS-20.

The few images available of the SF-A and the WS-20 show that the main high bypass fan on each have relatively narrow chord blades. The blades are also connected with mid-span supporting "snubbers". These were used by early Western HBTs from the 1960s to compensate for weakness in these larger blades.

China's aerospace ambitions are hobbled by the lack of the "Chinese Heart", or modern aircraft engines

In May 2013, Galleon reported SF-A could begin production in 2016, but other reports from late 2013 note that testing was under way and production might not start until 2017 or 2018. These reports also noted that by 2008, SF-A was judged to have insufficient performance for future Chinese airliners, but pending development, may still be used.

BUSINESS JETS

Galleon also reported that by 2015, Shenyang-Liming would be producing the 2,000lb-thrust Jiuzhai twin-spool turbofan, intended for light business jets. However, this cannot be confirmed. Jiuzhai is usually associated with the Cirrus SF50 Vision light jet. China Aviation Industry General Aviation, a division of AVIC, purchased Cirrus in 2011.

According to Galleon, the AVIC Guizhou-Liyang Aero-Engine Group was to start producing the 16,000lb medium-thrust WS-12C HBT in 2015, but this cannot be confirmed either. It is intended to power the Comac ARJ-21 regional airliner, which currently uses GE's 15,400lb-thrust CF34-10A. The WS-12C is likely derived from the 6,400lb-thrust Chengdu-built Minjiang, revealed at the 2008 Zhuhai air show.

The Guizhou and Chengdu air and engine concerns appear to be developing deeper co-operation. Perhaps in the late 1990s, Chengdu began a programme to co-produce or copy the D-30KP-2, known as the 24,000lb-thrust WS-18A. Galleon reports the WS-18A that reportedly powers Xian's Y-20 transport and H-6K medium bomber started production in 2009. It could enter "commercial" service if the Y-20 were purchased by a commercial airline. »



The Jiuzhai twin-spool turbofan was associated with the in-development Cirrus SF50 Vision light jet in the past

Cirrus Aircraft

It appears that after 2005, political dissatisfaction with the ability to develop and produce modern commercial turbofans led to a second stage in China HBT development: reform within AVIC to spur better results.

INSTITUTIONAL FOCUS

In January 2009 it was decided that AVIC would increase institutional focus on commercial engines by the creation of its ACAE unit as an "integrated" engine concern. ACAE literature states it is "responsible for the design, R&D, assembly, test, sales and service, technology development and technology consulting of commercial aircraft engines in China".

ACAE has established its new design, R&D, technology development and consulting facilities in the Minhang-Shanghai area. A new large production and test centre is being built in the Shanghai-Pudong-Lingang area.

However, the high-profile revelation of a half-scale mock-up of ACAE's CJ-1000A turbofan in June 2011, about two-and-a-half years after ACAE's founding, at least suggests that it may have relied on established companies like Shenyang and Xian for early design work. It may also have adopted the reportedly more advanced SF-B.

ACAE's website indicates that it regularly seeks advice from other established engine design, production and development organisations; indeed, it lists nine that contributed to an April 2015 ACAE-organised seminar on project configuration management for its CJ-1000AX demonstration turbofan.

From 2012 to 2014, limited information about the CJ-1000 turbofan family has been revealed. In 2012, Lucintel Consulting of Irving, Texas revealed the CJ-1000 would include three initial versions: the CJ-1000AX demonstrator, that would produce 12.8t of take-off thrust; the CJ-1000A early production model, with up to 14t of thrust; and the CJ-1000B, an extended-range version that would produce 13.4t of thrust.

At the May 2014 propulsion summit, ACAE senior expert for design and R&D Ni Jingang, who worked with Safran China from 1997 to 2010, provided projected milestones for the CJ-1000 family. The AX demonstrator would be finished by 2018 – two years later than previously reported. By 2022 the A version would equip the C919 and the B would follow by 2026, with certification between 2022 and that time.

Given the delay encountered by the CJ-1000AX demonstrator, the projections for production and certification may also prove optimistic.

While it did not refer to the CJ-1000, an ACAE brochure on its engine programme from the 2012 Zhuhai air show lists the potential technology improvements the CJ-1000 may exhibit: wide-chord, curved, swept hollow main fan blades; single crystal-powdered metal blades with "advanced cooling technology" for the high-pressure turbine; curved-swept blades for the high-pressure compressor; compact single annular combustors; plus full authority digital engine control and "advanced engine fault diagnostics".

The Guizhou and Chengdu air and engine concerns appear to be developing deeper co-operation

Reports from 2011 indicated that a future version of the CJ-1000 could have a thrust of 44,000lb, but at the 2014 summit, Ni also revealed that a new "CJ-2000" was being developed for a future widebody airliner in the 250-300 seat class, with engine certification between 2025 and 2030. A 50,000-60,000lb thrust rating is plausible.

During a press conference at June's Paris air show, a representative from Russia's United Aircraft Corporation indicated that a Chinese-Russian engine development programme was possible for a proposed joint widebody airliner. Other Russian sources at the show indicated that the 28,000lb-thrust Aviadvigatel PD-14 could serve as the basis for a more powerful turbofan.

At the 2014 summit, Ni also referred to a "CJ-500" intended for smaller regional jets, but did not provide additional details.

NEW EFFICIENCIES

A third phase in China's development of advanced turbofans could emerge from the 2014 decision to form an entirely new engine organisation from AVIC's distributed companies and institutes. According to Chinese reports, AVIC Engine will gather 25 to 27 engine-related units and 80,000-85,000 personnel. An AVIC website describes it as "engaged mainly in military and civilian aircraft engines, helicopter transmission, secondary power systems, gas turbines and other derivatives product development, manufacturing, marketing and services business".

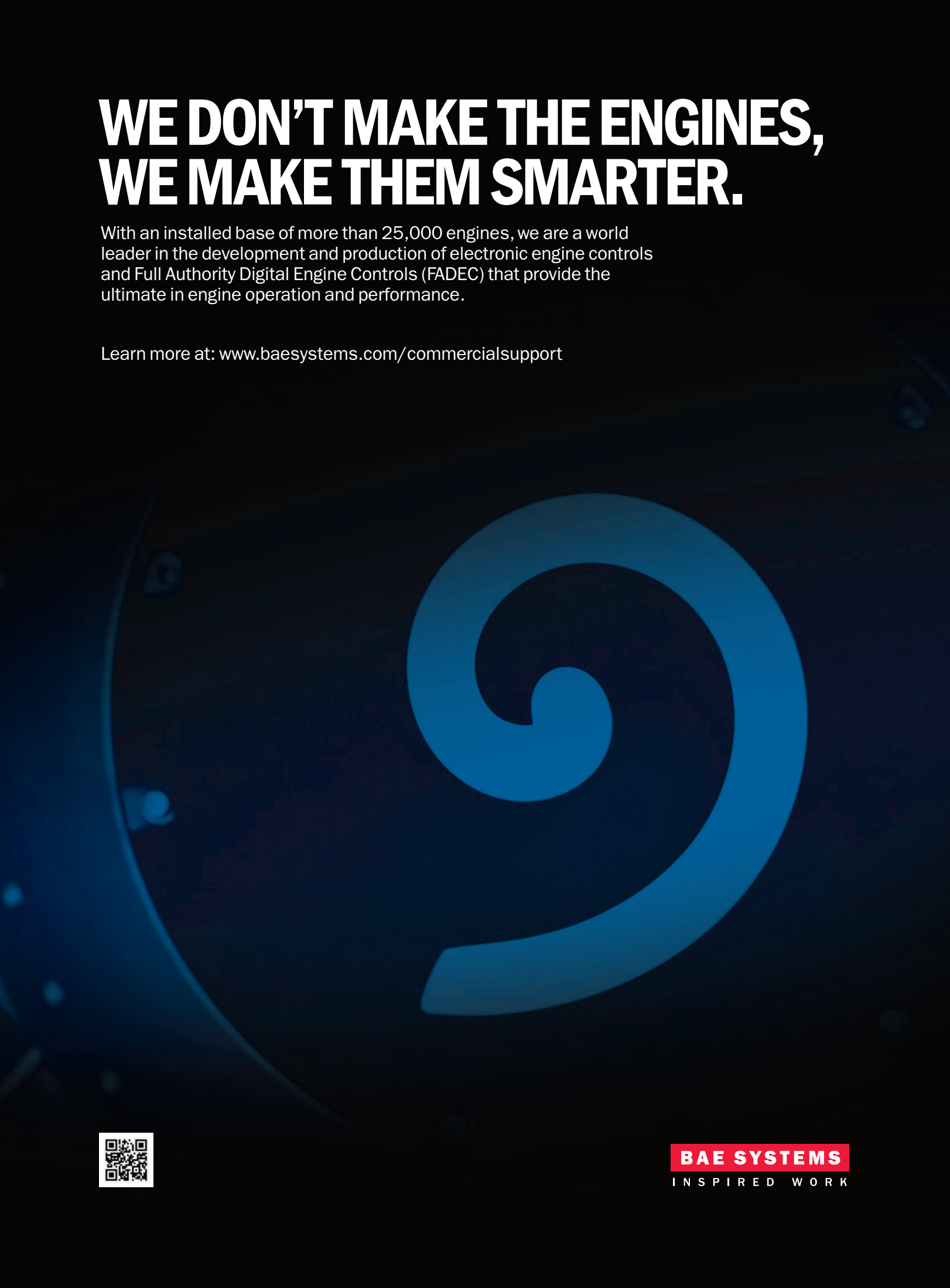
A decision to move beyond reform from within, like with ACAE, towards wholesale restructuring may reflect concern that even ACAE's new CJ-1000 family may be continually behind Western turbofans. However, what is not known is how AVIC Engine will move to achieve new efficiencies, perhaps maintaining some internal competition or perhaps seeking much greater specialisation among subordinate companies.

But this effort to form a world-class engine sector could receive substantial funding, with Chinese reports indicating that up to CNY2 trillion ($322 billion) could be spent over the next 20 years. ■

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Stephen Trimble/Flightglobal

The show's home at Congonhas has been the subject of much debate, with some calling for LABACE to be held at a larger location in São Paolo

LACKING LUSTRE

This year's LABACE in Brazil comes at a time when the region's business jet market has been hit by economic malaise after years of against-the-grain growth

KATE SARSFIELD LONDON

The 12th Latin American Business Aviation Conference & Exhibition (LABACE) will open its doors on 11 August in a region mired in political and economic instability.

The three-day, annual event – held at Congonhas airport in São Paulo, Brazil – is now a permanent fixture on the aviation calendar thanks to the significance of the region to the business aircraft industry.

With an installed base of more than 2,700 business jets and turboprops, Latin America is home to the third largest business aircraft fleet by continent, after North America and Europe. While its position on the continental fleet roster is assured for some time to come, Latin America is losing its lustre as the deepening financial crisis takes its toll on new aircraft sales.

"While the region provided a consistent stream of business jet orders during the worst of the worldwide financial crisis, the pendulum has now swung the other way, which is simply part of the ebbs and flows of economic market cycles," says aerospace analyst Brian Foley.

RECOVERY TIME

This malaise is likely to continue until the end of the decade, he predicts. "Based on the amount of time it has recently taken other business jet markets to recover, it's not inconceivable that Latin America could be sub-performing for the next five years," says Foley.

The economic misery has been felt most acutely in the region's powerhouse and business aviation beacon, Brazil.

This country is home to the largest and youngest business aircraft fleet in Latin America and the biggest inventory outside the USA. Its installed base of 793 business jets and 712 turboprops represents about 55% of the Latin American fleet, with Venezuela and Argentina a very distant second and third, respectively (*see graphic, P36*).

As with the rest of the continent, Brazil is experiencing one of its worst financial downturns in more than a decade and the short-term prospects for the world's seventh-largest economy are grim.

"This uncertainty is impacting heavily on sales of new and used aircraft, which have dropped to critical levels," says Eduardo Marson, chairman of Brazil's business and general aviation trade body, ABAG.

"People are either unwilling to purchase aircraft or are delaying their decision until there is a turnaround in the economy. This won't happen for a while," he predicts. "It's really tough."

Compared with previous downturns, however, Marson observes there is a trend for owners to hold on to their assets rather than sell them to free up liquidity. "In the past financial downturns, owners would sell their assets, usually abroad, and this would be reflected in the declining fleet numbers," he says.

"This isn't happening this time around. There is a huge value attached to owning and operating an aircraft within this vast coun-

try," adds Marson, who is also the president of Brazilian helicopter manufacturer and Airbus Helicopters subsidiary Helibras.

Brazil's huge land mass has been a key driver in the growth of business aircraft in the region.

The country has 5,600 cities, but fewer than 130 of these are served by scheduled airlines. In contrast, there are 4,000 airports and aerodromes in Brazil, of which business aircraft, according to ABAG, serve the majority.

"Business aircraft are critical to the development of Brazil," says Marson. "They open up new towns and cities by providing a transportation link to the remotest areas. Propeller-driven aircraft are a lifeline to many communities and businesses."

WIDESPREAD ACCEPTANCE

Marson's view is supported by aerospace analyst Rolland Vincent. He believes the hallmarks of convenience and flexibility have been instrumental in business aircraft gaining widespread acceptance with owners and operators throughout Latin America and in Brazil in particular.

"It's a large, populous nation with entrepreneurial cultures, clutches of highly successful, high net worth individuals (HNWI) and limited commercial air service networks and infrastructure," he says.

Latin America has by far the largest number of business jets per wealthy individual of any major world region, Vincent reveals. He singles out Brazil, with 5.2 jets per 1,000 HNWI. "This compares favourably to North America – 2.7 jets per 1,000 HNWI – but especially to Europe and the Asia-Pacific with 0.6 jets and 0.2 jets per 1,000 HNWI respectively," says Vincent.

"This year's LABACE is bigger than in 2013 and about the same size as last year's"

EDUARDO MARSON
ABAG chairman

It is a view echoed by Marson. He points to the recent trend in Brazil towards owned and managed aircraft and away from the traditional charter market. "Access to business aircraft by companies and individuals was usually through an air taxi operator," he explains. "But in recent years there has been a shift towards outright ownership, particularly amongst those companies, private owners and entrepreneurs who use business aircraft regularly," he says. "While aircraft are now being sold in fewer numbers [compared with the boom years of the mid- to late 2000s], the value placed on these assets is just as important."

Elsewhere in Latin America, the business aviation landscape is equally fragile. Venezuela and Argentina – with fleets of 595 and 268 respectively – are both struggling with recession and the prospects for new business aircraft sales are poor.

The economies of Chile and Colombia are growing, but the rich pickings are minimal given their shares of the Latin American fleet.

DURABLE SHOW

Despite the gloomy backdrop, ABAG is hoping Latin America's only business aviation showcase will be a success. Around 70 exhibitors have committed so far, including all the major airframers and LABACE regulars: Bombardier, Dassault, Gulfstream, Textron and local player Embraer, which launched its business jet division at the show 10 years ago.

"This year's LABACE is bigger than the 2013 event and about the same size as last year's," says Marson. "This is pretty impressive given the dire economic climate."

The static area will be home to around 70 aircraft, including a VIP-configured ATR 72, which is making its show debut along with Embraer's in-development Legacy 450. LABACE marks the first public outing in Latin America for the latter, a super-light business jet earmarked for certification and service entry this year.

Congonhas airport has been home to LABACE since the show's inception. However, as the show has grown in size and stature, many exhibitors and visitors believe it has outgrown the venue. They have called for it to be shifted to a larger site within São Paolo, such as Campo de Marte in the north of the city, which



Embraer

The in-development Legacy 450 will make its Latin American debut at LABACE, with service entry planned for later this year

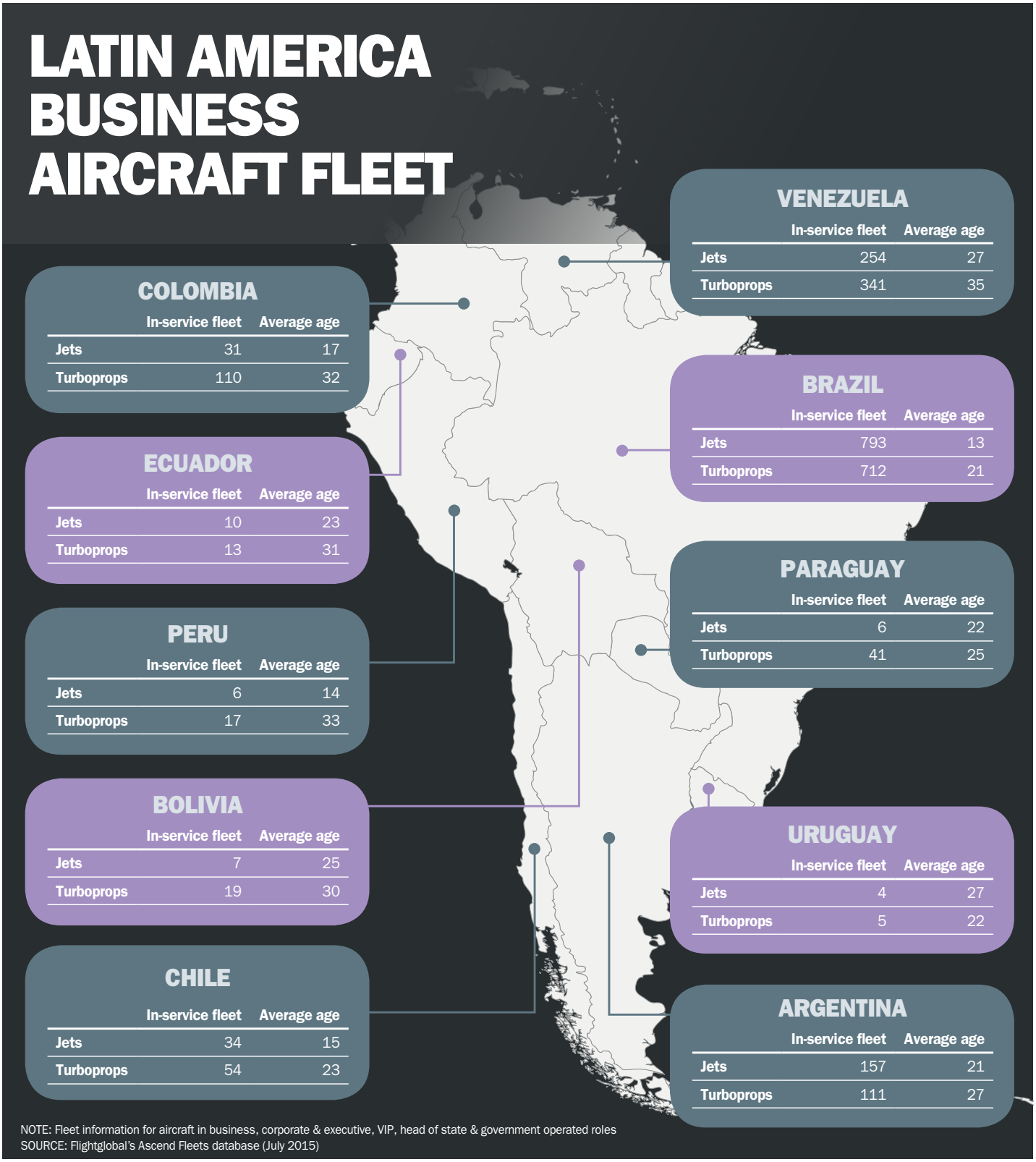
» is close to the financial district.

Relocating the show to a larger, fresher venue would not only give the exhibition more breathing space, they argue, but would also reflect the importance of this niche industry to the Latin American market. Says Vincent: "It is time to showcase this major industry event at a new location that provides ample space – this would be a significant improvement over today's venue."

While LABACE's location may be causing come disquiet, industry's long-term confidence in the Latin American market remains undiminished. In its latest 10-year market forecast, Embraer predicts demand for 850 new business jets worth $16 billion, with Brazil continuing to account for the bulk of the sales.

"In spite of economic recession nowadays, we still see the country as an important market," says Embraer, which is close to delivering its 200th business jet on the continent. "LABACE will continue to be a great show to promote our products and services in the region." ■

LATIN AMERICA BUSINESS AIRCRAFT FLEET



COLOMBIA

	In-service fleet	Average age
Jets	31	17
Turboprops	110	32

ECUADOR

	In-service fleet	Average age
Jets	10	23
Turboprops	13	31

PERU

	In-service fleet	Average age
Jets	6	14
Turboprops	17	33

BOLIVIA

	In-service fleet	Average age
Jets	7	25
Turboprops	19	30

CHILE

	In-service fleet	Average age
Jets	34	15
Turboprops	54	23

VENEZUELA

	In-service fleet	Average age
Jets	254	27
Turboprops	341	35

BRAZIL

	In-service fleet	Average age
Jets	793	13
Turboprops	712	21

PARAGUAY

	In-service fleet	Average age
Jets	6	22
Turboprops	41	25

URUGUAY

	In-service fleet	Average age
Jets	4	27
Turboprops	5	22

ARGENTINA

	In-service fleet	Average age
Jets	157	21
Turboprops	111	27

NOTE: Fleet information for aircraft in business, corporate & executive, VIP, head of state & government operated roles
SOURCE: Flightglobal's Ascend Fleets database (July 2015)

France will take the spotlight as "feature country" at Singapore

SINGAPORE AIRSHOW 2016 16–21 Feb

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Singapore Airshow 2016 will welcome France as the Feature Country in the fifth edition of the show, scheduled to take place from 16 to 21 February 2016, at the Changi Exhibition Centre.

The Feature Country series, which made its debut at the 2014 Airshow, was developed as a permanent feature to enable the companies exhibiting within the pavilion to leverage on the Singapore Airshow as a strategic platform; lending support to businesses of the Feature Country and enabling them to tap the opportunities in the Asia Pacific region and beyond.

The French Pavilion will be located at a prominent spot within the exhibition hall. Participating exhibitors will have access to a dedicated "Deminar" area – a demonstration and seminar area for research institutes and universities to showcase their latest technologies and innovations. In addition, business meetings between the French Pavilion exhibitors and VIP delegations will also be specially facilitated.

"Being a Feature Country at the Singapore Airshow 2016 gives us the unique platform to bring together our latest and best aviation technologies to meet the growing appetite for innovation in the Asia Pacific aviation sector, translating into real business deals for our French companies," said Emeric D'Arcimoles, the Paris Air Show Chairman and Chairman of the





International Committee of Groupement des industries françaises aéronautiques et spatiales.

The French aerospace, defence and security industry is worth 47.9 billion Euros, and specifically, out of which 30.4 billion Euros is contributed by exports. This shows that France is well-placed to leverage its Feature Country platform to bring its latest innovations to the region's top decision-makers converging at Singapore Airshow 2016.

This comes at an opportune time in the Asia Pacific aviation industry, where the commercial aerospace sector is expected to set new records for aircraft production in 2015, off the back of the accelerated replacement cycle of obsolete aircraft and growing passenger travel demand in the Asia Pacific region. Countries in the region are also increasing defence spending to equip their militaries with modern defence platforms and technologies.

Reflecting this growth is the continued expansion of reach and impact of each new edition of Singapore Airshow. The 2016 show is already 80 per cent committed, with specialised spaces like the Aerospace Emerging Technologies Zone, the Training and Simulation Zone and the introduction of the Business Aviation Zone, to further spawn business development opportunities.

For more information about the Feature Country programme, please contact Mr Danny Soong at dannysoong@experiaevents.com or +65 6595 6123.

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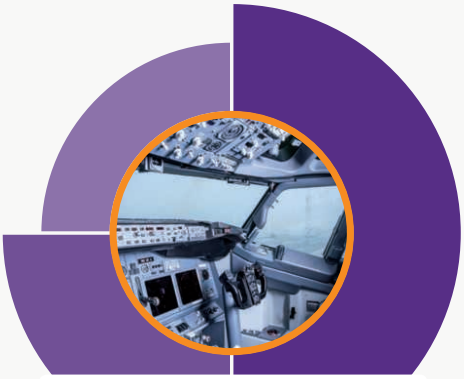
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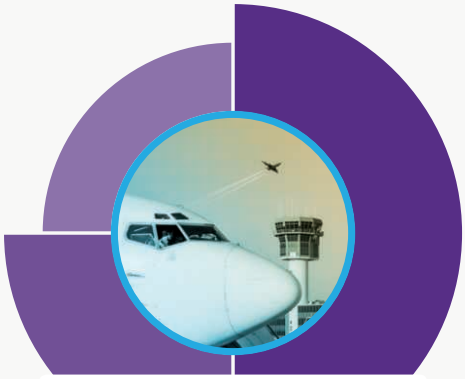
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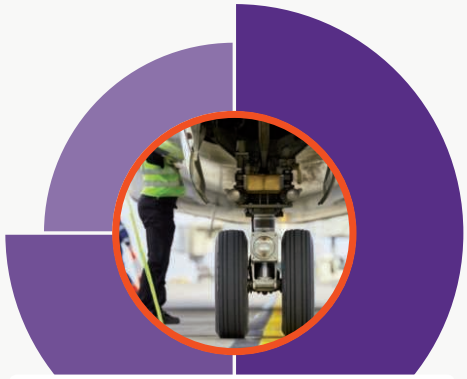


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Rutan reveals... not quite all

Burt Rutan is famously secretive about his aircraft designs. The man behind SpaceShipOne, Voyager and the Starship has been busy working on a new design for a wingship/seaplane called the SkiGull. He had hoped to reveal the new aircraft in spectacular fashion at the Oshkosh AirVenture show in July, but production flaws forced him to scratch the plan.

But Rutan broke from procedure and briefed the Oshkosh crowds about the SkiGull design anyway, adding an unusual caveat up front.

"I'm going to do something that is against my policy, and that is, I'm going to talk to you in detail about an aircraft that has not yet flown. I want to advise you up front: these are estimated stuff and it's probably bulls---."

Metal revival

Still from Oshkosh, one of the most fascinating aircraft "launches" was a new version of a type first flown in 1919.

A suitcase manufacturer – yes, that's right, Rimowa, which specialises in upmarket aluminium luggage – revealed the Rimowa F13, a replica of the Junkers F13, the world's first all-metal aircraft.

Designed as Germany was trying to establish a civil aerospace industry from the ruins of the war, the F13 was one of the most innovative aircraft of the inter-war era.

Chief executive Dieter Morszeck, who unveiled the four-passenger replica at Oshkosh in a "Roaring twenties" style event, promises that it will fly next year.



Definitely not recycled suitcases



Geoff Jones

"I don't care what the 'F' you call it, sir, you can't park it here." (The F-35 mock-up gets the once over from the local constabulary at RIAT. Thanks to Geoff Jones for the picture)

Duralumin, the material discovered by Alfred Wilm in 1906, is the link between the aircraft firm and Rimowa, Hugo Junkers using it to build his aluminium aircraft and Richard Morszeck, founder of Rimowa, for his range of suitcases.

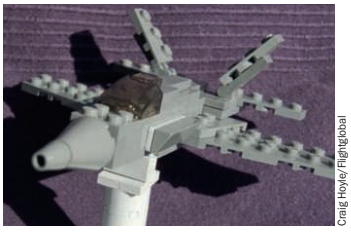
That wasn't hard

Meanwhile, everyone at Oshkosh remembers the Airbus A380's unfortunate hard landing in crosswind conditions upon arriving in 2009. So all eyes were fixed on the A350-900, which made a flawless touchdown. A350 chief test pilot Frank Chapman noted that the A380 incident was certainly on the mind of the crew as well.

"When I came here yesterday, there was a lot of pressure to get the landing right. And as we came into the final turn through about 100ft, the guys [on board] said, 'Don't f--- up the landing'."

Assembly problems

On the other side of the Atlantic, Lockheed Martin's eager employees were out in force at July's Royal International Air Tattoo, inspiring the next generation of total aviation people with clever tech including a 3D printer and



Craig Hoyle/Flightglobal

Testing, even for a test pilot

information about the Orion crew capsule for NASA.

But the opportunity to build an F-35 Lightning II from Lego was particularly popular, with kids signing up to follow a 13-step production process using prepared kits. Busy young minds were barely distracted when a famed UK test pilot arrived on the scene, but one dad was heard to comment: "You can fly it? Do you know how to build it? It's bloody impossible!"

Yuckspeak of the week

Tom Sheppard pulls Boeing up on a Yuckspeak, quoted in our 21-27 July issue. A spokesman notes that a design milestone for the 787-10 "validates priorities and progress to ensure that the design will meet all requirements when engineering is released to production".

In other words, says Tom: "It'll be okay." He adds: "They just can't help it, can they?"

Just hot air

100 YEARS AGO

Zeppelins have been able to accomplish a certain amount of mischief. But when analysed in the light of war operations as a whole, these overboomed airships must be written down as absolute failures so far as military value is concerned.

Waste not...

75 YEARS AGO

The services, not excluding our well-beloved Royal Air Force, are not always meticulously careful in avoiding waste of human material. Even the RAF sometimes insists on its human aluminium boiling cauliflowers when it ought to be used in Spitfires. We insist that human material is precious, and that waste of it should be absolutely abolished.

Hover bother

50 YEARS AGO

Any hopes that the suzerainty of the Ministry of Technology would have a driving and dynamic effect on Britain's ACV efforts withered on 27 July. Ironically, this was the very day on which the Queen had her first ride in a hovercraft.

Shades of grey

25 YEARS AGO

The renewed conflict between the USA and Europe over allegations of unfair subsidies to Airbus Industrie reflects no credit on the industry or politicians. This is a dispute for which there is no obvious solution: it is one in which there are not even definable shades of grey.

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15-16 September
Flight Safety Symposium
London, UK
flightglobalevents.com/flightsafetysymposium2015

15-18 September
DSEI 2015
ExCel, London, UK
dsei.co.uk

29-30 September
Aviation Partnership Summit
Amsterdam, The Netherlands
flightglobalevents.com/APS15

29-30 September
New Generation of Airline Passenger Systems
London, UK
flightglobalevents.com/pss2015

1 October
US Corporate Aviation Summit
Fort Lauderdale, Florida
aeropodium.com/uscas

1-2 October
Central Asian Aviation Symposium
Almaty, Kazakhstan
aeropodium.com/caa

6-8 October
Helitech International
ExCel, London, UK
helitechevents.com

14-15 October
Aerospace Innovation Forum
Palais des congrès, Bordeaux, France
www.aerospace-innovation-forum.com

20-21 October
The Commercial UAV Show
ExCel, London, UK
terrapinn.com/exhibition/the-commercial-uav-show

8-12 November
Dubai Airshow
Dubai World Central
dubaiairshow.aero

15-17 November
ALTA Airline Leaders Forum
San Juan, Puerto Rico
alta.aero/airlineleaders/2015

17-19 November
NBAA 2015
Las Vegas, USA
nbaa.org/events/bace/2015

17-19 November
Aerospace & Defense Meetings Torino
Torino, Italy
bciaerospace.com/turin

19-20 November
Safety In African Aviation
Kigali, Rwanda
2gether4safety.org

1-2 December
Military Airlift and Rapid Reaction Operations
Seville, Spain
smi-online.co.uk/defence/europe

8-10 December
Aerospace Meetings Brazil
São Paulo, Brazil
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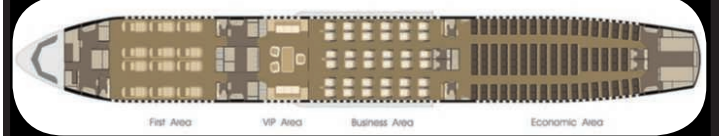
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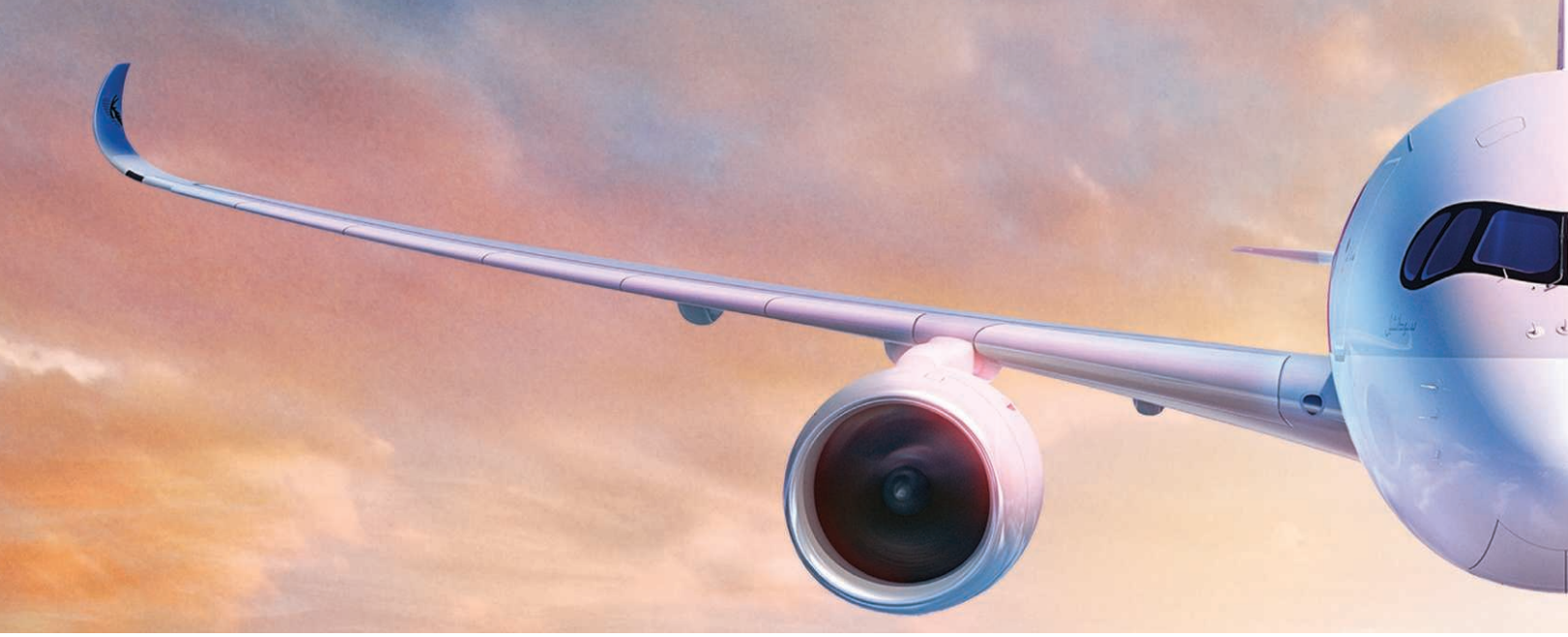
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There's optimism in the air in Qatar

Throughout the capital city of Doha, there is endless evidence of progress and forward movement. And nothing signifies this rapid rise more than the careers on offer at its national carrier, Qatar Airways, which is looking for ambitious pilots to join its team.

Captains and First Officers

Qatar Airways is one of the fastest growing airlines in the world. And as part of its expansion, opportunities are available for talented pilots looking to become Direct Entry Captains and Direct Entry First Officers.

Young Fleet

There are many reasons for aspiring Captains and First Officers to join the World's Best Airline, as voted by our passengers for the 2015 Skytrax Awards. Just one example is the recent addition of the Airbus A350 XWB to the fleet.

Qatar Airways is the global launch customer of this state- of-the-art aircraft, giving potential recruits a chance at flying the world's latest generation Airbus. With over 330 aircraft on order, a global network of more than 140 destinations and 158 aircraft in the fleet, an opportunity to fly for this dynamic airline is hard to turn down. The growing network of destinations is also exciting—Qatar Airways added 12 new destinations to its route map last year and has already announced three new routes to the USA (Los Angeles, Boston and Atlanta) for 2016.

Life in Doha

Situated on the north-eastern coast of the Arabian Peninsula, this country of 2 million people has come a long way from its humble beginnings. Its vibrant Qatari heritage is now combined with the energy of a modern city, and Doha presents a safe environment, ideal for families to grow and flourish.

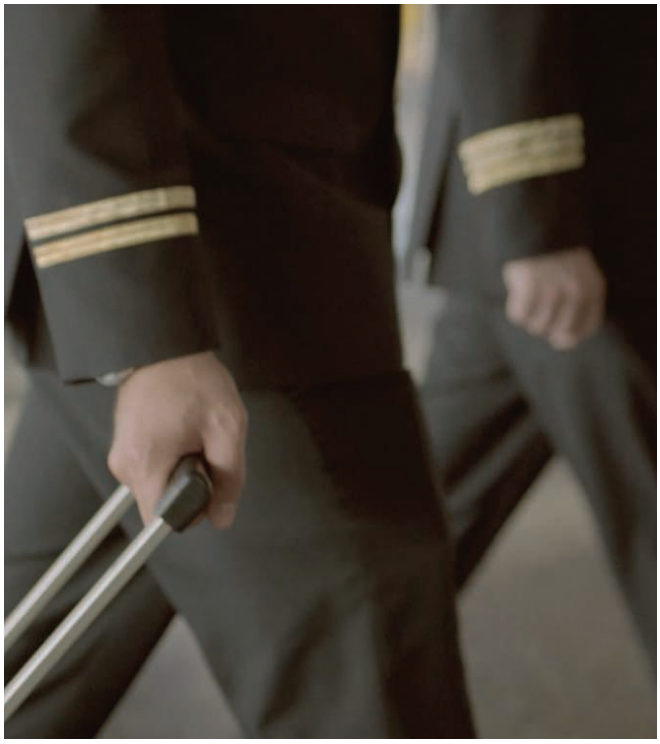


FAST-RISING AS DOHA.

Benefits

The amazing perks are all part of the attraction of working for Qatar Airways. As well as flying a modern fleet, pilots enjoy packages that include housing, medical and educational benefits. Living in Doha also provides a diverse lifestyle, and in their free time, pilots and their families get to enjoy many leisure activities, such as desert adventures, watersports and shopping. And if this isn't enough of an incentive, a career at Qatar Airways provides job stability and satisfaction, as well as a tax free salary from one of the world's leading airlines.

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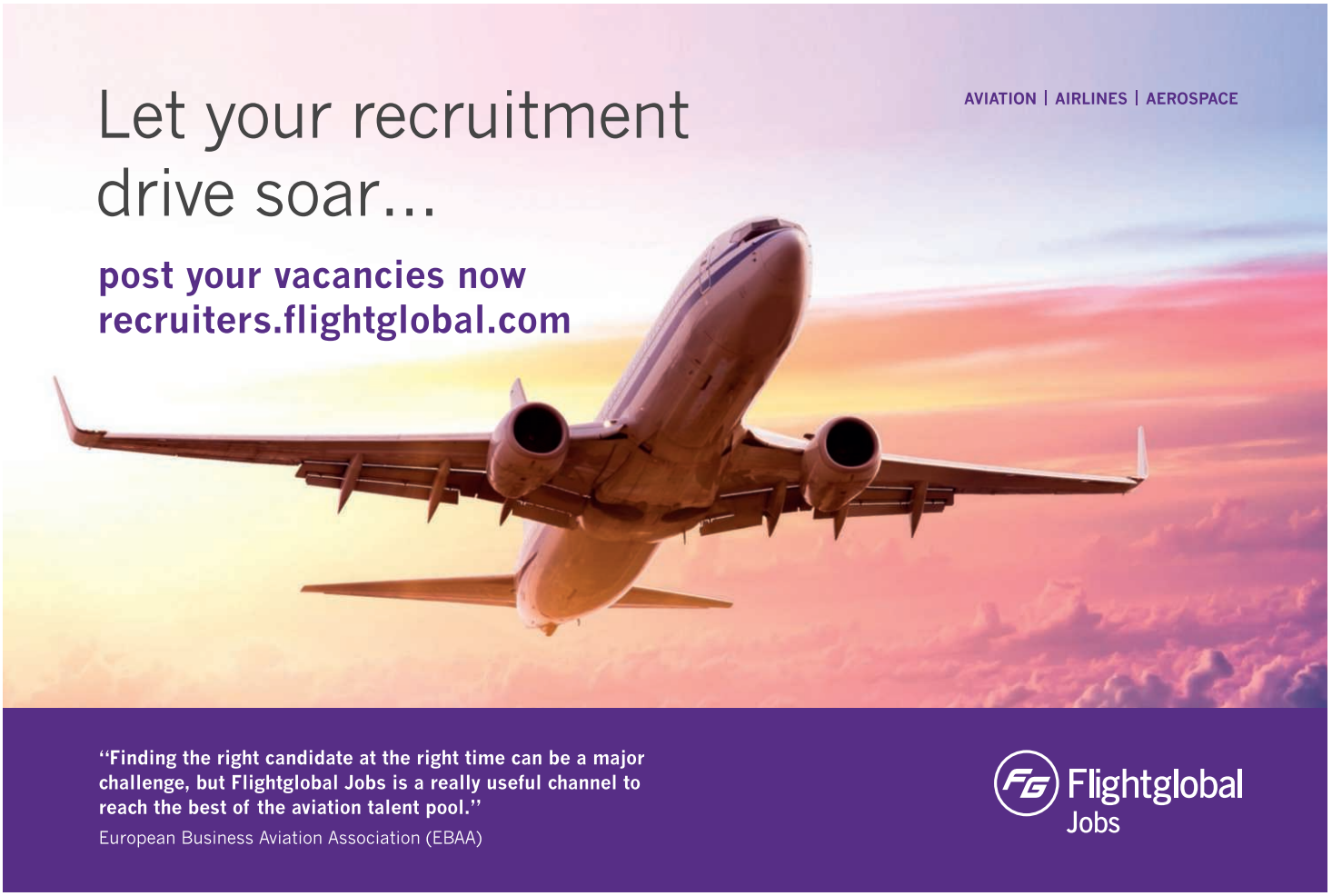
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WORK EXPERIENCE AMY BURNS

Seeking safer skies for the USAF

Amy Burns is automatic collision avoidance technology programme manager at Wright-Patterson AFB in Ohio. She develops software and systems to prevent air accidents – but she also holds a world speed record

How did you start out?

Between my junior and senior year in college, I interned for a research and development support contractor for the Air Force Research Laboratory (AFRL) at Wright-Patterson AFB, Ohio. I worked on researching and developing path-finding algorithms for multiple unmanned air vehicles that were executing a mission with multiple tasks, including pop-up tasking.

After earning my bachelor's degree in aerospace engineering at Virginia Tech, I decided to progress to the next stage. I received my master's degree in aerospace engineering in 2005.

You began your work with the US Air Force?

I started working at the AFRL in the Air Vehicles Technology Assessment and Simulation (AVTAS) laboratory. After more than nine years I moved to my current job in the control systems branch, where I lead the automatic collision avoidance technology programme.

What other projects have you been involved with?

In college I was part of the human-powered submarine team. We designed, built and raced both non-propeller-driven and propeller-driven submarines. In 2004 I set the women's world speed record in the one-pilot, non-propeller-driven submarine category with Virginia Tech's submarine, called Specter. My top speed with this submarine was 3.427kt (6.3km/h). My involvement taught me a great deal about developing paper concepts and about making those concepts a working reality.



US Air Force

Burns's goal is an integrated system to stop air and ground collisions

I have worked with students from the Air Force Institute of Technology and Test Pilot School on many different projects in the AVTAS laboratory. One that was particularly interesting looked at the handling qualities of a supersonic, tailless air vehicle. Multiple simulation evaluations were conducted in a dome-type simulator before this concept was flight-tested in the Calspan-operated Convair NC-131H total in-flight simulator. As part of this effort, I had the opportunity to ride on board, and observe the flight from the front cockpit.

I also worked with General Dynamics and the Human Effectiveness Directorate to develop a study that looked at reducing fatigue on [Lockheed Martin] F-16 pilots during long flights, through the use of various self-adjusting seat cushion concepts.

What are you working on at the moment?

My team has developed an automatic ground collision avoidance system (Auto GCAS) to protect fighter pilots from controlled flight into terrain (CFIT) accidents. This system was transitioned to the F-16, F-22 and F-35 programme offices. The F-16 programme office integrated it on their Block 40/50 fleet at the end of 2014.

My team is in the process of expanding this solution for aircraft with analogue flight control computers, specifically focusing on the pre-Block 40 F-16s under our hybrid technology programme. My team is also working on maturing our automatic air collision avoidance system (Auto ACAS) that is being designed to protect fighter pilots from mid-air collisions. This system was flight-tested in 2014 at Edwards AFB. My team's next goal is to combine Auto ACAS with Auto GCAS under our automatic integrated collision avoidance system effort, thus maturing the technology in hopes of transitioning it in late 2017 to the F-16, F-22 and F-35 programme offices.

What needs improvement?

In the past there have been multiple manual warning systems added to the F-16 to try to protect the pilot from CFIT accidents. However, the problem with all of these systems was they caused nuisances to the pilot. The pilots therefore ignored or turned off these systems and the accident rate per flight hour did not change. Therefore it is critical to develop and field a system that is nuisance-free so pilots will use it. Our team believes Auto GCAS can protect against over 90% of CFIT accidents and Auto ACAS will protect against at least 75% of mid-air accidents. ■

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